MAY, 1942

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PITTSBURGH SUN-TELEGRAPH

Tin Salvaged By Screen At Incinerator

A new screen in the ash conveyor of the city incinerator may bring the city an annual revenue of $40,000 a year while it provides 7,500 tons of scrap iron for defense industries, according to D. C. Agar, manager engineer of the Bureau of Refuse. On Su

SALVAGE

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MECHANICAL SEPARATION OF VALUABLE METAL WILL IMPROVE REFUSE FILL AND PROVIDE A WELCOME PROFIT TO YOUR MUNICIPALITY.

At Pittsburgh, Pa., this ROBINS-GYREX Vibrating Screen separates tin cans and other scrap metal from incinerator ash. By this means the city contributes more than 25 tons of scrap per day to the War Effort. Removal of tin cans has also vastly improved the character of the fill at the refuse dump. This whole installation paid for itself in less than a month, and now brings Pittsburgh a very tidy income.

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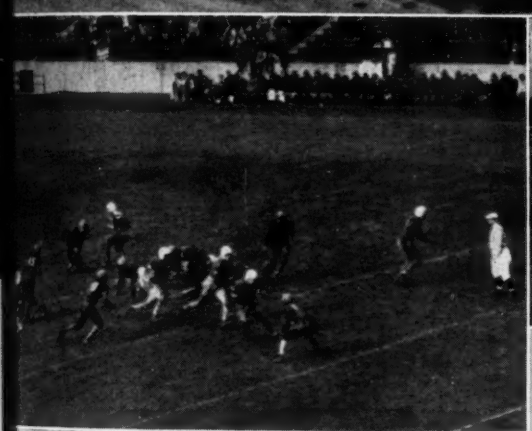

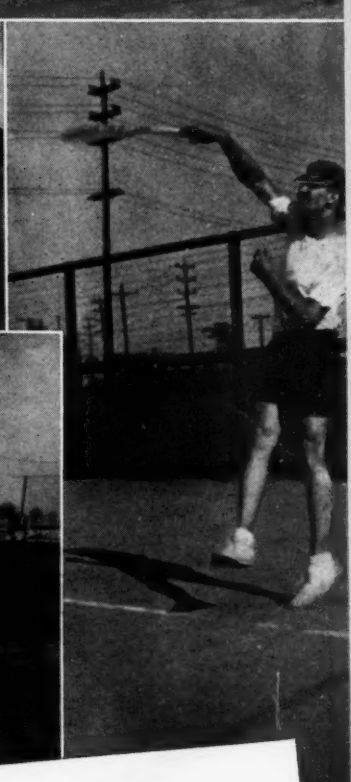

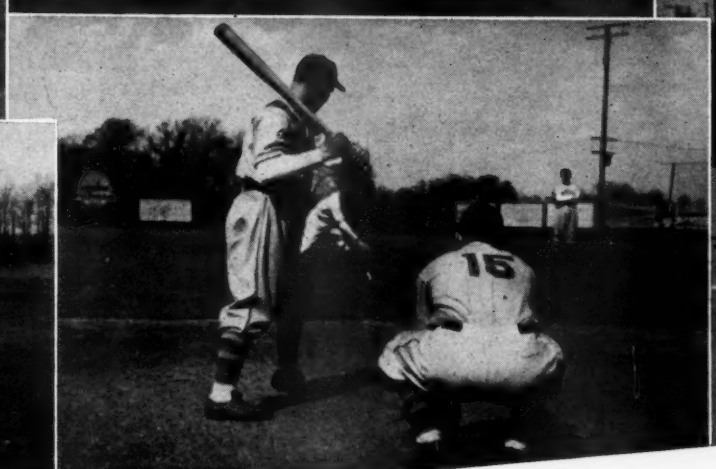

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The Editor's Page

Road Maintenance Is of Paramount Importance

The chief concern of highway officials, both state and county, from now on will be *maintenance*. Even should there be little new construction except that necessary to serve army camps and new war production plants, maintenance alone will be more than enough to use all the men, equipment and money available.

One reason for this is the increasing wear by traffic. Although the tire and car situation is reducing the amount of pleasure traffic, this is more than offset on the most important highways by the greater amount of heavier traffic, from buses (carrying passengers who formerly used light passenger cars) to heavy military traffic. Some roads that suddenly became essential to the constructing and servicing of new war plants were never intended for heavy traffic and are deteriorating rapidly. The California Division of Highways estimated late in February that "damage to highway surfaces by defense hauling, in recent months, shows a total of over $1,600,000 is required for adequate restoration. Of this amount some 64 per cent is required on non-strategic highways."

These war traffic highways *must* be kept in serviceable condition. The time is rapidly approaching when our output of war materials will be limited not by our ability to manufacture them but by the rate at which raw materials, parts and accessories can be got to the plants and the completed products be removed from them.* With a plant turning out a hundred truck loads of products a day, temporary storage cannot generally be found for many days' output, and if it cannot be removed promptly the plant must slow down or shut down temporarily. Moreover, the main highways must be kept in condition at all times for the use of our mechanized troops.

Money, men, materials and equipment are necessary for maintaining these roads. The money can be found; if not by the state, then the Federal government will add to the millions already appropriated for the purpose. Men now in the department experienced in maintenance work should be retained. Some of them may feel that it is more patriotic to work in war plants or enter the army, but as a matter of fact their most patriotic service is to stay where they cannot readily be replaced in this essential work, rather than do direct "war work" for which plenty of others would be equally satisfactory.

As for materials, there should be little difficulty in obtaining what are necessary. The recent construction conservation order does not apply to maintenance and repair work, and a high priority rating can be had for highways carrying war traffic. Steel reinforcement stands near the head of the WPB list of materials scarce for non-war work; but there is little necessity for this in highway maintenance. Asphalt, tar, cement, tile and stone are placed at the bottom of the list; and these are the chief materials used in maintenance work.

Equipment is going to be the most difficult problem. With the maintenance work increasing in importance and amount, those states and counties (if any) which owned plenty of equipment for previous requirements are likely to find this will no longer be the case. Some have made a practice of renting privately owned trucks, power shovels, tractors and similar heavy equipment; but most of such equipment is now working full time on war projects and probably will not be available for highway work. Maintenance officials therefore should obtain by purchase as much as possible of the equipment needed for maintaining their roads under the difficult conditions that are developing; should overhaul and put in the best condition possible the equipment they now have; and try to arrange with neighboring counties and states for mutual exchange of equipment as their relative requirements vary from time to time.

In purchasing new equipment, priority regulations must be observed. We suggest that manufacturers of the equipment desired be asked immediately if they can furnish it provided a priority rating be obtained. (They probably can tell what rating is obtainable under the conditions described by the applicant, and how to obtain it.) If they cannot supply it, try the manufacturer of such equipment who is second choice; or try to get other equipment which can be used for the purpose although possibly not so effectively.

We urge prompt action. Under the most favorable conditions to be expected it will take some time to get the needed equipment; and with the heavy traffic which is rapidly increasing, deterioration in a road surface once started will progress rapidly unless given immediate attention.

*The Federal Works Agency reports that of 749 Michigan corporations manufacturing war materials, 70% receive 50% or more of their incoming materials by truck and 38% receive 90 to 100%; while 76% ship 50% or more of their products by truck and 43% ship 90% to 100%. And 75% of the workers reach these plants by automobile.

Salvaging for War Needs

There is great and immediate war need for iron and steel scrap, paper, rubber, cotton and wool rags and other materials present in most municipal refuse. The amount of these salvageable is greater than many realize. Pittsburgh, Pa., as described elsewhere in this issue, is recovering scrap metal at the rate of more than 30 lb. per capita per year.

In addition to performing a patriotic service, cities salvaging such materials can generally sell them at a net profit. Pittsburgh nets $150 a day from the sale of its salvaged metal. Moreover, waste used for fill is more sanitary and compacts better if the tin cans have been removed.

It is even better if these materials be kept separate by the householders and collected separately by the town. In some towns citizens are asked to (and most do) wash all tin cans, cut out top and bottom and flatten them, in which shape the town collects them. And there are few towns not cursed with vacant lots and surrounding areas littered with old metal objects, from cans to automobiles, which should be removed for pride if not patriotism and profit.

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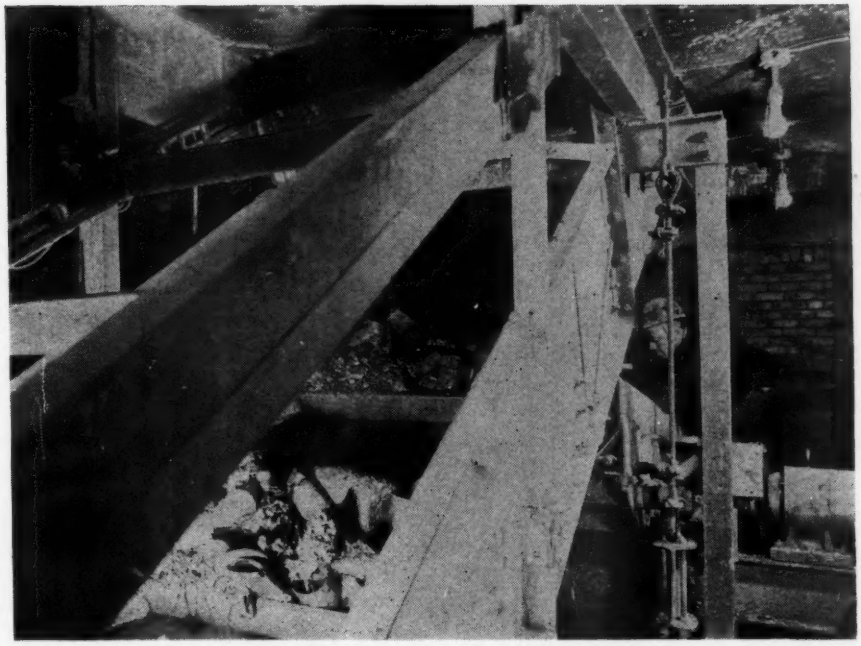


Scraper conveyor discharging incinerated refuse onto vibrating screen, shown in the background

Recovery of War Scrap Metal Nets Pittsburgh a Handsome Profit

By D. C. AGAR

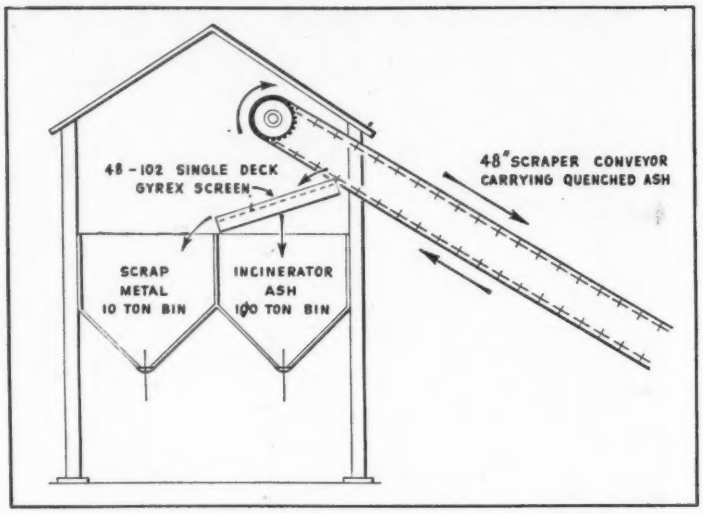
Managing Engineer, Bureau of City Refuse, Pittsburgh, Pa.

Recently installed screen salvages from the city's refuse over 800 tons monthly of scrap metal for war purposes, and each month nets the city more than the installation cost.

PITTSBURGH'S incinerator plant consists of four 150-ton crane-fed brick furnaces with an annual throughput of about 200,000 tons of mixed refuse. Each furnace has four cells which discharge residue from the incineration through individual chutes (water sealed) into a water-filled trough, from which scraper conveyors cause the material to be moved and discharged onto a second conveyor leading to a residue bin.

The furnaces operate without auxiliary fuel, the moisture content of the refuse being low enough and the combustible content being high enough to allow this condition. The average annual operating temperature is approximately 1800 degrees F. The plant operates to a tolerance of one per cent of organic matter and five per cent of combustible matter in the incinerator residue on a physically distinguishable basis.

The conveyor troughs (in which the water is about four feet deep) thoroughly quench the residue, cause the disintegration of almost all of the clinkers and impart a moisture content of approximately thirty per cent to the material as it leaves the storage bin. The extent of the disintegrating effect may be judged from the fact that the two men in attendance on the screen



Sketch of screen house, showing location of vibrating screen

(to be discussed later) can readily pick from a screen all non-metallic items such as matted paper and rags, clinkers and unburned wood at peak flow (20 tons per hour). An important effect of the water troughs seems to be to prevent the filling of metal containers with residue, as most of them reach the screen empty or in such condition that the contents are removed by the vibration. The extent to which this condition would apply to containers quenched at the discharge gates of ash chutes in the drive-thru ash tunnel type of plant would have to be the subject of study.

Household Treatment of Refuse, Extent and Composition of the Same

The population of Pittsburgh is 675,000, and its refuse as described below amounts to approximately 200,000 tons per year. The city makes combined collection from all households of wrapped garbage, combustible rubbish and non-combustible rubbish; the last including household scrap metal and glass, with the large metal items such as bedsteads, refuse containers, refrigerators and stoves separated before feeding the furnaces. (This article refers only to metals in the residue from burning.) The city collects, in addition, garbage from hotels, restaurants and non-processing commercial establishments, but no rubbish from these places. The method of collection is from the rear exterior of the house, which method seems to have discouraged scavenging almost completely.

Before the present emergency, there was very little salvaging except by charitable agencies such as the Salvation Army, etc. It is interesting to note that a war scrap drive in April had very little effect on household scrap metal in the incinerator residue.

Pittsburgh has no municipal ash collection, this service being performed privately expressly without the inclusion of refuse. Our figures on household scrap metal should be fairly inclusive, therefore.

In the month of March, the first month of operation of the screen, described herein, we separated 4.75 per cent of the incoming refuse as scrap metal. In the week ending April 25th the separation amounted to 4.69 per cent. From visual inspection of the ash that went through the screen and to the dump, there appeared to be an additional one-half of one per cent in the form of bottle caps, can tops, wire, etc. (When we tried screen sizes smaller than 2"x3" the contamination of the scrap by organic and combustible items became objectionable.) Household scrap in this city recoverable by screening, therefore, appears to be about five per cent, or about 32 pounds per capita per year.

In addition to the screened scrap, our collectors bring in about 2 pounds per capita per year of the large metal items above referred to.

Metal Salvaging and Markets Prior to the Present Installation

The Pittsburgh incinerator plant, which was placed in operation in April, 1940, in common with almost all plants installed in the last two decades, did not include a sorting plant. However, large household scrap metal items, with the exception of galvanized and tinned materials, were separated before going into the furnaces or, if inadvertently charged, were pulled out of the furnaces before going into the conveyors; and small black iron scrap to a very limited amount from the wet mass of residue in the final conveyor was picked by hand to an aggregate amount of less than 500 tons per year. This material was sold to contractors, who at first took only the large items and later ineffectively picked the conveyor and trucked the material to the several baling presses in the city. The first contract price in 1940 was $3.50 per net ton and the present price is $7.50 on the same basis but without the small conveyor scrap.

There was no market for incinerated or bright tinned food containers; in fact, they could not be given away in this district until the spring of 1941. After much persuasion, the contractor at that time agreed to pick the few cans possible and pay the city one dollar a ton for them on an experimental basis. Subsequently these materials began to have increased value, reaching the present contract price of $6.30 per net ton loose, delivered to the contractor's trucks at our plant.

Tin cans in normal times are practically unsalable as scrap, even if baled, because of the tin content of approximately two per cent of fresh unprocessed cans and its effect on steel-making, because of the large amounts of foreign matter in bundles made from rusted cans salvaged from dumps, and because of the extra control required if disproportionate quantities of these materials are used in making steel. With the present all-out steel production, and speaking for small household scrap metals separated by my process and averaging less than one-half of one per cent tin, reasonable and easy dispersion among steel-making units should give no reason for grumbling and should allow this material to be judged and priced in scientific relationship to other scrap.

The Agar Screening Process for the Separation of Household Metals from Incinerator Residue

Early in 1941 I got the idea of applying the screening methods used in the byproduct coke industry (with which I was familiar) to the separation of household metal scrap from the incinerator residue agglomerate. It was necessary to reject many plans involving costly installations to arrive at a process which, should it fail, would not involve too much financial loss. The failure of almost every attempt to mechanize refuse sorting and disposal over many years and the reluctance of municipalities to experiment injected a decided element of risk.

A vibrating screen of the Robins Gyrex type was set up as the bidding standard. This screen, placed to receive material from the final scraper conveyor where it discharged into the ash bin, was 48" wide by

102″ long, and had 2¼″x8″ openings (later replaced by a screen with 1¾″x4″ openings) with the screen cloth made from half-inch rod, and was powered by a three horsepower motor. The screen was of the suspended type and was attended by two laborers for three shifts per day. It was installed on March 2nd and was a success from the start. The screen was equipped with two barriers 2″ high to increase the tumbling effect and consequent cleansing effect, and delivered a product containing only 3½ to 4 per cent of ash, which would remain on a concrete surface after the cans had been forked from it into a baling press. The first month's operation of the screen yielded 660 tons of salable metals and this month of April is producing about the same percentage of incoming material.

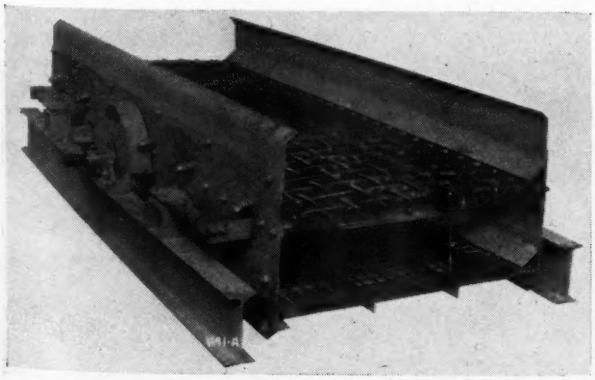
In our case the existence of a conveyor system and the construction of the ash bin made the installation comparatively inexpensive and we were fortunate in the availability of commercial baling presses, having none of our own. It would be misleading to give the cost of our installation as a guide to other cities because of the many variables affecting refuse collection and disposal but I believe the demonstrated success of the operating unit will be helpful. It is too early to give figures on maintenance but the cost will be extremely low, as these are hardy pieces of equipment, and in other industries give years of useful service.

To those unfamiliar with a vibrating screen, the operation consists of imparting a circular motion in the direction of the long dimension of the screen, in this case 650 times per minute, the motion having a radius of one-half inch. This was chosen along with other screen characteristics as most favorable to success with this kind of material.

The screen is set at a downward angle of about ten degrees, but can be set at any other angle should this be found desirable to insure optimum flow and operation.

Tests of the motor under maximum load conditions show it to be only about 75 per cent loaded. Incidentally, the motor in the steamy and moist atmosphere that prevails in our set-up called for a moisture-proof and dust-proof unit, which we obtained.

The materials screened out, besides food containers, include baling wire, furniture springs, small garbage cans, stoves, kiddie cars, pipe, radio chasses, and many such items that we were mightily afraid would clog the screen. The mass of residue appears to be strongly cohesive as it falls on the screen, but the "through" material passes in the first third of the screen allowing the "over" material to be tumbled and jostled for an appreciable time to free it from ash. The chief duty of the two laborers is to remove large clinkers and wire and other material that might catch in the screen cloth.



A two-deck "Gyrex" screen, showing vibrator and base construction used at Pittsburgh

Truck being loaded with scrap metal through gate from 10-ton bin.

The cans and metals removed occupy almost 50 per cent by volume of the residue fed to the screen, which effects a transportation saving and allows the forming of sound landfill without the instability and settlement that occurs when cans are deposited with the residue.

Some General Figures and Conclusions

The process in Pittsburgh at the present rate and contract price should supply 10,000 tons a year of scrap for the war effort and return $75,000 gross and $60,000 net to the city, allowing for the screen-attending labor and proportionate maintenance but not including overhead, as it was unnecessary to employ supervisory forces. The installation cost was considerably less than $5,000—one month's net return to the city from sale of the scrap.

These figures assume that the price ceiling for this type of scrap would be a fair proportion on an iron and tin content basis to other steel scrap, which ceiling would allow processing, baling and transporting costs, in addition to the metal bearing a pro rata share of the city's collecting and processing cost.

WPA Salvages 6,600 Tons of Streetcar Rails in Month

More than 6,600 tons of abandoned streetcar rails, containing scrap steel equivalent to the amount required for four modern destroyers or 325 medium tanks, were removed from city streets by WPA workers during March, F. H. Dryden, Acting Commissioner of Work Projects, said on May 6th. WPA has been removing old streetcar rails throughout its program—in growing amounts since last fall—and announced a new arrangement with the War Production Board which is expected to increase the rate still further. The plan involves adaptation of the nation-wide WPA salvage collection project to rail removal from city streets.

Strea
When tc

Making a small patch, using a Littleford "Spray Master"

MAINTENANCE is of increasing importance for the coming indefinite period when all of the nation's energies will be directed toward the successful prosecution of the war. The absolute necessity of maintaining our streets and highways in suitable condition to carry the increased traffic load due to war requires that maintenance efforts and maintenance efficiency be increased. To assist our readers toward that end, PUBLIC WORKS will publish articles, of which this is the first, giving definite and usable information on maintenance methods and maintenance equipment.

One of the difficult things to determine in street maintenance is whether to patch a given area or to resurface it. We asked a number of city engineers what basis they used. Answers given herewith represent only a small part of those received. However, many of the replies were indefinite; as "Depends on condition of base and the size and depth of worn parts"; in general, information given here will be restricted to definite statements.

C. L. Longson, superintendent of public works, Burlingame, Calif., says they patch when the breaks in the pavement consist of isolated areas; otherwise they resurface. In El Centro, Calif., says Ralph H. Congreve, city engineer, the relative area of necessary patches to the total area of the street determines the procedure, but the relation is not given. Geo. E. Baker, city engineer of Long Beach, Calif., says that a badly broken surface over a good subgrade is resurfaced, but if the breaks are scattered they patch.

In Los Angeles, Calif., as reported by H. B. Cortelyou, engineer-director of the Bureau of Maintenance and Sanitation, "foremen and superintendents inspect and make detailed written reports on broken and cracked pavement, improper drainage, etc. Traffic is counted; roughness is recorded by machine. The streets in the worst condition are resurfaced and the others patched." Merced, Calif., G. E. Winton, city engineer, determines the indicated cause of failure; if this is due to breaks in subgrade, patches are used; if the pavement is cracked or failed, it is resurfaced. C. C. Bonebrake, city engineer of Orange, Calif., says that unless the street is very rough, with many broken places "we patch it. It is hard to say just what percent is the dividing line." In Oxnard, Calif., E. O. Imus, city engineer, small depressions are patched and cracks are poured. The percentage of surface breakdown controls resurfacing. Palo Alto, Calif., L. Harold Anderson, city engineer, resurfaces only in the event of a general breakdown of the pavement.

Geo. S. Hinckley, city engineer of Redlands, Calif., has a simple and excellent formula: "We try to resurface before the street rides uncomfortably." C. L. Dimmitt, city engineer, Redwood City, Calif., also bases resurfacing on percentage of surface needing repair (What percentage, please, Mr. Hinckley?—Ed.). In San Rafael, Calif., R. A. Boege, city engineer, the type of subgrade, type of pavement and extent of disrepair determine the method; and in Santa Paula, S. G. Bennett, city engineer, there "is no basis, but we patch and patch till we have money enough to resurface." (There are a lot in that same boat, Mr. Bennett). Frank E. Alderman, city engineer of South Gate, Calif., resurfaces when it will save the existing surface as a base. Traffic volume and riding characteristics are the guides in Stockton, Calif., Lyle Payton, city engineer.

If more than 30% to 40% of the street surface is damaged and needs repair, the area is resurfaced in Grand Junction, Colo., Jas. D. McGillis, city engi-

Photo courtesy The Barrett Div.

Making a medium-size tar patch

aintenance Practices—
tch and When to Resurface

Hundreds of engineers from all sections of the country report their practice in deciding whether to patch or resurface a given area.

A large patching job in Alexandria, Va., being rolled with an Austin-Western roller

neer; if not more than 30% or 40% is damaged, the street is patched. In Trinidad, Colo., Harmon H. Kellum, city engineer, repairs are made when the oil mat begins to break up. George E. Thompson, city engineer of Derby, Conn., says the question is one of the budget and of the area involved. William F. Neirintz, city engineer, Torrington, Conn., says that if the surface shows general signs of wear it is resurfaced, but if there are holes only, it is patched.

Down in Florida, it seems that a different basis for patching vs. resurfacing is used. J. H. Philpott, city manager, Fort Lauderdale, Fla., says policy is determined by the attitude of the property owners, as resurfacing is assessed against abutting property. L. L. Lee, city manager of Miami, Fla., says "spotty failures are patched and failures of a general nature are rebuilt." Columbus, Ga., H. W. Rattray, city engineer, patches cuts and holes, but resurfaces if badly worn and showing signs of disintegration. Decatur, Ga., W. H. Weaver, city engineer, resurfaces if the required patches would cover 25% of the surface. Allen L. Fox, city engineer, Blue Island, Ill., resurfaces if more than 15% of the area is affected. In Des Plaines, Ill., E. N. Fletcher, city engineer, if the cost to patch is more than 10% of the cost to resurface, the street is resurfaced.

A street is resurfaced in Lake Forest, Ill., Neil N. Campbell, city engineer, when the pavement surface shows signs of disintegration. In Lincoln, Ill., Conrad Miller, resident engineer on street construction, the street is resurfaced if it is unusually rough but without surface breaks. Wilmer Wilson, city engineer, Marion, Ind., considers the condition of the surface, the number of holes needing patching and the thickness of the surfacing. Muncie, Ind., H. Lester Janney, city engineer, patches where there are just pot holes and resurfaces when more than 50% of the surface area becomes cracked or raveled. And out in Terre Haute, Robert E. Gibbons, city engineer, says streets are resurfaced when they get rough enough to break the springs in your car.

George H. Gilbert, city engineer, Clear Lake, Ia., recommends resurfacing when maintenance costs are great enough to capitalize the cost of a new surface. In Clinton, Ia., Benton R. Anderson, city engineer, resurfacing is placed if patches cover 25% of the area and the remainder is in poor shape. J. M. Tippee, city engineer, Des Moines, Ia., considers age and condition as a whole of the surface, attitude of property owners and ability to pay for the improvement. In Dubuque, Ia., Paul A. Rossiter, city engineer, resurfaces when maintenance exceeds $50 per year per city block. In Eldorado, Kans., H. E. McMillen, city engineer, streets are patched when combined area of holes does not exceed 10% of surface area, subject to some extent to the condition of the balance of the paving.

Bangor, Me., P. H. Glover, city engineer, resurfaces if the surface needing repairs is more than 10% of the total. In Hudson, Mass., A. M. Custance, resurfaces "when it is cheaper, everything considered; otherwise patch." Frederic C. Holmes, superintendent of streets, Lee, Mass., uses personal judgment as to whether the particular street is one that can be patched and not look too bad. In Natick, Mass., B. G. Sargent, superintendent of public works, says "we resurface if there is a general breaking up of the street, but patch occasional holes. In Rockport, Mass., Matt A. Hautala, town engineer, the general practice is to resurface, but patches are placed if the street is not in too bad condition. Cornelius W. Phillips, superintendent, Springfield, Mass., states "when cost of maintenance equals or exceeds interest, sinking fund charges and annual maintenance of a new pavement, the street is resurfaced."

Frederic R. Storrer, city engineer, Dearborn, Mich., judges the need by the depth and extent of the holes; if these are small, patches are placed. In Escanaba, Mich., A. V. Aronson, city engineer, holes 1 inch or more in depth are patched and then surfaced; if rough, the street is surfaced. If over 50% of the area is involved, Flint, Mich., Otto K. Philipp, city engineer, resurfaces with W.P.A. Jackson, Mich., John M.

(Continued on page 24)

Building housing Muskegon Heights Filter Plant

The New Water Supply

By GEORGE F. LIDDLE

City Superintendent and Engineer, Muskegon Heights

THE city of Muskegon Heights, Michigan, last fall put into service a new waterworks plant, construction of which began in 1940 and the cost of which was $1,294,986. It was largely a WPA project, the Federal funds totaling $819,420. This new plant was constructed to provide for obtaining the city's supply from Lake Michigan. (The former supply had been from wells, but lowering of the ground water table was rendering it inadequate.) The new construction included an intake, low-lift and high-lift pumping stations, filter plant, reservoir, and 4⅔ miles of pumping mains connecting the low-lift pumps with the filtration plant and this with the high-lift pumps.

The Intake

The intake is 4,600 ft. long, a 30″ enamel-lined and bitumen-coated steel pipe with a wall thickness of ⅝ in. The pipe was used in 60 ft. and 120 ft. lengths, the shorter ones being placed near the shore where the excavation was heaviest. The pipes were joined under water with bolted sleeve couplings, and two 1½ in. harness bolts were used across each coupling to prevent the pipe from pulling out of the coupling. The pipe was laid in a trench excavated by a clam-shell dredge mounted on a scow, the minimum depth of the trench, at the intake crib, being 9 ft. below lake bottom, the water here being 45 ft. deep. Provision is made for flushing the intake in case it should be plugged with ice.

The Low-Service Pumping Station

The intake pipe ends at a low-service pumping station about 100 ft. from the water's edge. Here are installed three vertical turbine pumps, two of 3.5 mgd capacity and one 5.25 mgd; space being provided for three more units. The pump bowls, the bottoms of which are 23 ft. below lake level, are placed directly in the suction wells. Current is obtained through one power line only, but a 125 kva generator driven by a 250 hp gasoline engine was installed as a stand-by. Both pump motors and generator are mounted on the motor room floor, well above high-water level of the lake.

To catch any sand that may enter the intake, the water on its way to the pumps is passed through a sand chamber which has a detention period of 5 minutes at a flow of 10 mgd, and from which accumulated sand can be flushed into a sump and pumped back into the lake.

From the sand chamber the water passes to one of two screen chambers and from there to two suction wells. The screens are hand cleaned, being raised by an auxiliary hoist mounted on a 5-ton crane and cleaned onto the floor by means of a spray. Provision is made for by-passing the sand chamber; also for dewatering either of the suction wells and screen chambers, the other being used meantime.

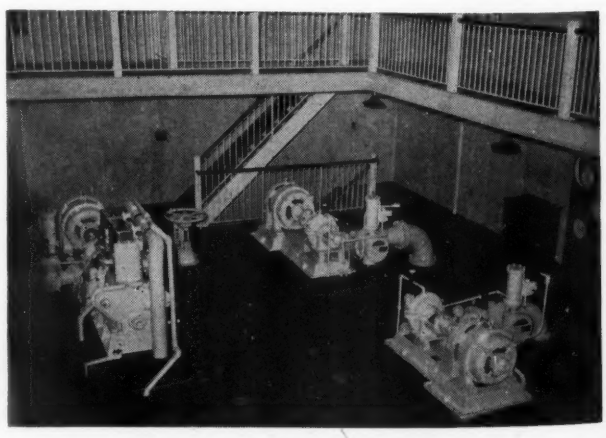
This pumping plant is housed in a reinforced concrete structure, 36 by 40 ft. outside dimensions, with the bottom of the base slab 29 ft. below normal lake level. Excavation for the structure was accomplished without sheeting by using well points and four dewatering pumps, which were run continuously during the construction period of 6½ months, beginning early in 1940. The station was placed in service June 1, 1941.

The Filter Plant

The filter plant is located on a high sand dune 3,200 feet inshore from the low-service pumping station, which delivers the water into a rising well, where the chemicals (alum and carbon) are added. From the rising well the water flows downward through a rapid-mixing tank, then divides and flows upward through two coagulation or reaction tanks, whence it passes through a settling tank to the filters and thence to the clear wells and filtered water reservoir.

The mixing tank has a detention time of 1½ minutes and the coagulation tanks have a detention time of 10 minutes at 7 mgd., which is the nominal capacity of the four filters. The stirring mechanisms in the mixing and coagulation tanks are of the paddle type, each driven by a variable-speed electric motor through a gear reducer.

The settling tank has a detention time of 4 hours and 30 minutes. It has five bays, each bay being approximately 16 feet wide. The two easterly bays



One end of high-service pump room

ystem of Muskegon Heights, Michigan

The system is changed completely from wells (which were becoming inadequate) to lake water. Describing the intake, low and high service pumping stations and 30-inch concrete mains.

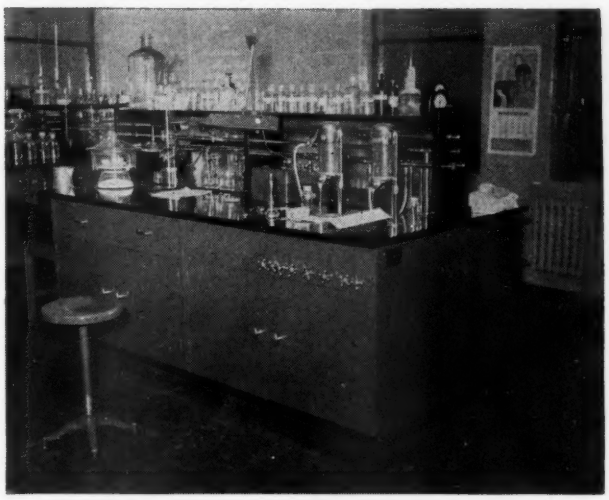
have no baffle wall between them. The sludge in these two bays is mechanically scraped into two sumps at the north end of the tank, from which it may be drained to the wash-water drain through two 6″ cast-iron pipes. All valves in sludge lines are of the lubricated plug type. Provision has been made for periodically flushing the sludge from the other three bays, a gutter 12″ wide and deep extending the full length of each bay of the settling tank and sloping downward toward the north, while the floor on either side of each gutter is pitched to it. Three 1½ inch hose bibs are provided at the south end of the tank, to which flushing hoses may be attached.

A 24″ cast-iron pipe conveys the water from the settling tank to four filters, each of which has an area of 494 square feet, and contains 30″ of sand on top of 18″ of gravel. The maximum operating water level in the filters is approximately seven feet above the top of the sand, which provides adequate flexibility. The under-drainage system consists of cast-iron lateral piping and manifolds. The flow from each filter passes through a rate-of-flow controller, located in the pipe gallery, directly to the clear well underneath the filters.

Water for washing the filters is provided by two 10,000 gpm wash-water pumps, either of which will provide a 30″ rise at its duty point; the rate of wash being controlled by a 24″ wash-water controller.

In front of each filter in the operating gallery is a furniture steel operating table of latest design, on which are two start-stop push-button stations for controlling either wash-water pump, and five pilot valves which control the hydraulically operated valves on the filter influent and effluent lines, the wash-water inlet pipe, the wash-water drain pipe and the filter rewash (filter to drain) line. A loss-of-head gauge and a rate-of-flow gauge complete the equipment on each table. A large dial at one end of the gallery indicates the washing rate in inches of rise in the filter bed per minute. Provision has been made for the future installation of surface wash piping if it should be found to be desirable.

The water from each of the clear wells flows into the west suction well, where it may be chlorinated. It then flows into a 1,750,000 gallon filtered-water reservoir. From here it flows by gravity through a 30-inch pipe line to the storage reservoir located in the center of the city; but piping connections permit using the wash water pumps as booster pumps to increase the flow should the gravity flow be temporarily insufficient.



A corner of the laboratory

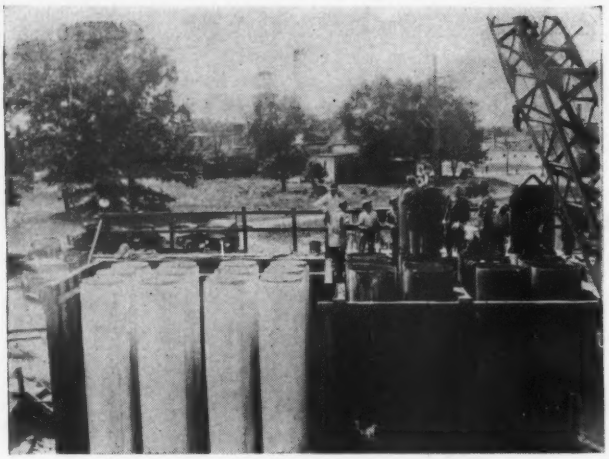
On the ground floor of the building are an entrance vestibule, two toilets, a work shop, and a garage. On the second floor are the chemical feed room, chlorine room, laboratory, office, shower room and filter control gallery. The chemical storage room is located on the third floor level and provides ample space for the storage of chemicals. The hoppers of the chemical feed machines (which are solution feed type) extend through this floor, which allows the chemicals to be fed directly from the storage room floor level. An elevator with a capacity of 2,000 pounds transfers chemicals from the ground floor level to the storage room.

A system of sample piping has been provided so that without leaving the laboratory, samples of water may be collected from any one of six different points in the treatment process.

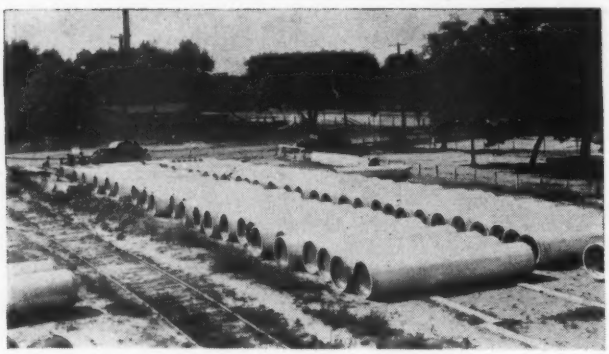
High-Service Pumping Station

The high-service pumping station and storage reservoir are located in approximately the center of the city. The station is 45 feet by 52 feet in plan, with substructure of reinforced concrete and superstructure of brick, with glazed tile interior walls.

Normally, the water from the filtration plant will pass to the 1,600,000 gal. storage reservoir, but it may be passed directly to the suction loop of the high-service pumps. A float-operated cone valve on the end of the transmission main automatically regulates the water level in the reservoir. The reservoir is divided



Pouring pipe for the connecting mains



Concrete pipe ready for laying

into two compartments, which facilitates periodic cleaning. An overflow weir between the two compartments allows the water to be maintained at the highest possible level in the smaller compartment, resulting in lower pumping heads on the high-service pumps.

There are five high-service pumping units: one 700 gpm, two 1,400 gpm, and two 2,100 gpm; all horizontal shaft, split-case centrifugal pumps direct-connected to electric motors. One of the 2,100 gpm units may also be driven by a 150 h.p. gasoline engine, which can be started in case of electric power failure.

The suction and discharge loop piping is located in a pipe basement below the pump room floor level, valves in it being so located that any pump may be isolated without affecting the usefulness of any of the other pumps. Check valves are of the cone type operated by a hydraulic cylinder.

A gauge panel in the pump room shows the rate of flow of the water in the incoming line to the reservoir and of that discharged from the station, the temperature and pressure of the water in the discharge mains, and the depth of the water in either compartment of the reservoir. Remote control push-buttons for the control of the pump motors have also been placed on this panel. The pump starters and all switches are located in a cubicle-type switchboard on the main floor.

A vacuum pump for priming the pumps under extreme low water conditions in the reservoir, a sump pump, and a five-ton crane complete the station's equipment. Space has been provided for a garage and meter repair shop.

Connecting Mains

The water is pumped from the low-service station to the filter plant and from that to the high-service station through a Lock Joint reinforced concrete pipe line 30″ inside diameter and 3 inches thick, made in sections 16 ft. long. The spigot end of each pipe had a groove cut in it into which a continuous round rubber gasket was placed, and when the pipe was laid, this gasket was tightly compressed by the beveled bell as the pipes were pulled together. The joint was cemented inside and out after laying. Fifteen hundred pieces were manufactured, including angles, beveled pieces for curves, manhole specials and odd lengths. A total of 24,585 ft. of this pipe was made and laid. The construction involved the use of 328 miles of ¼″ reinforcing wire reinforcement, 28 miles of ½″ longitudinal bars, 56 miles of 5/32″ bars and 4.1 acres of steel plate.

In the supply line between the filter plant and the high service station are two air relief manholes located at high points in the line and two blow-off manholes at the low points. Special pipes were made for these manholes with 6″ connections, and with boiler-type manhole frames cast into the pipe to provide a means of access directly into the line for cleaning and inspection. Each 6″ connection consists of a 6″ flanged piece cast into the pipe, on which is bolted a 90 degree bend and a 6″ gate valve with blind flange tapped for hydrant connection. In the high point manholes, the 90 degree bends are tapped and fitted with float type air release valves. An air vacuum release valve is installed in the line at the high point in the filter plant.

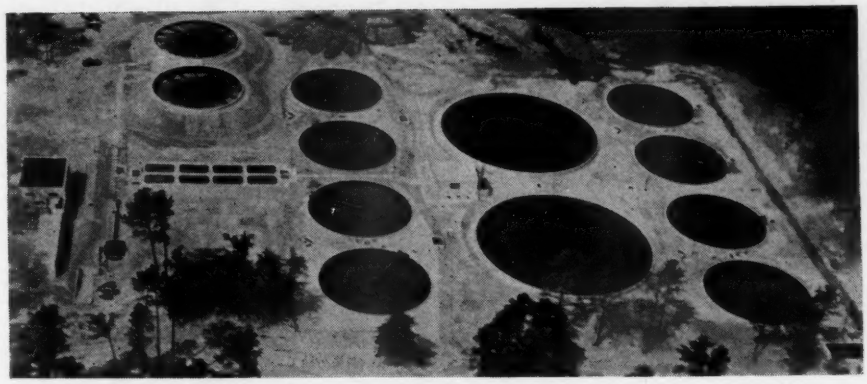
Surge relief is provided at the point where the line enters the high service station by three surge-relief valves set at 80, 82 and 84 ft. head, respectively. Provision has been made for three additional surge-relief valves by fittings cast into the pipe and capped. At points where the line changes direction sharply, either horizontally or vertically, the resultant thrust is counteracted by reinforced kick-blocks enclosing the angle and two feet of each of the two adjoining pipes. Sharp changes in direction were avoided wherever possible by the use of curves formed by bevel pipe.

Alongside of the pipe line that carries the water from the low-service station to the filter plant a similar line was laid to carry the dirty wash water from the filter plant back to the lake; provision being made to divert this water into a pond behind the sand dunes during the summer months so that it will not dirty the water on the beach.

Equipment Installed

The makes of the equipment mentioned were as follows: Well points, Moretrench; Vertical turbine pumps, Peerless; Steel intake pipe, Chicago Bridge & Iron Co.; Sleeve couplings, Dresser; Standby gasoline engines, LeRoi and Climax; Motors and generators, U. S. Motors; Screens, Van Dam; Mixing tank and coagulating tanks, Universal Gear Works; Settling tanks, Dorr "Monorake"; Stirring mechanism, city fabricated; Lubricated plug-type valves, S. Morgan Smith Co.; Rate-of-flow meters, Republic Venturi. Republic Orifice, Sparling propeller; Rate-of-flow controllers, Infilco, Inc.; Westinghouse electrical panel; DeLaval wash-water pumps; Omega chemical feeders; Wallace & Tiernan chlorinator; Detroit Elevator Company elevators; High-service pumps, American Well Works; Laboratory equipment, E. H. Sheldon & Company.

Shoecraft, Drury & McNamee and Greeley & Hansen served as consulting engineers on the project. C. A. Sirrine was director of operations for WPA. Frank P. Rockenbach was mayor.



Sewage treatment plant at Fort Bragg, North Carolina.

Courtesy the Link-Belt Co.

Sewage treatment plant at Camp Wolters, Texas

Courtesy The Dorr Co.

Operating Results on Five Army Biofilter Plants

Details of operation to date of sewage treatment plants at Camps Polk, Livingston, Wallace and Wolters and Fort Bragg. Average and peak flows. Daily B.O.D., suspended solids and pH analyses.

OPERATING results are now becoming available on the sewage treatment plants installed by the Army during 1940 and 1941. These plants are loaded up to or beyond design capacity in many cases, and it is therefore an opportune time to present a record of operating results of five of these plants.

It has not easily been possible to check the actual loadings on the filters or the removal effected. Recirculation of the primary filter effluent to the primary tank inlet reduces the strength of the primary tank effluent; and in the case of most of the plants the amount of recirculation varies. The data given herein are mainly based on monthly averages.

Camp Polk

The average water consumption is 97 gallons per day. The alkalinity of the treated water (water is treated with 1.92 p.p.m. of sodium hexametaphosphate for iron stabilization) is 62 p.p.m., and the soap-consuming power as $CaCO_3$ is 32 p.p.m.

Courtesy The Dorr Co.

Treatment plant at Camp Livingston, La.

Average sewage flow is 104 gallons per capita per day, including approximately 4.2 gallons per capita of laundry waste. Sewage flows are quite uniform, the average peak approximating 142% of the average, with a minimum flow about 43% of the average. The average B.O.D. per man per day is 0.1976 pound.

The Camp Polk plant is a single or split-single-stage biofilter. It consists of a comminutor, a grease trap, a primary clarifier, a biofilter, a secondary clarifier, and 2-stage digesters.

Based on a recirculation ratio of 2:1, the retention period in the primary clarifier is approximately 3.25 hours. In some cases, filter effluent is recirculated to the dosing siphon instead of to the distributing well ahead of the primary tank. This results in a longer detention period in the primary tank.

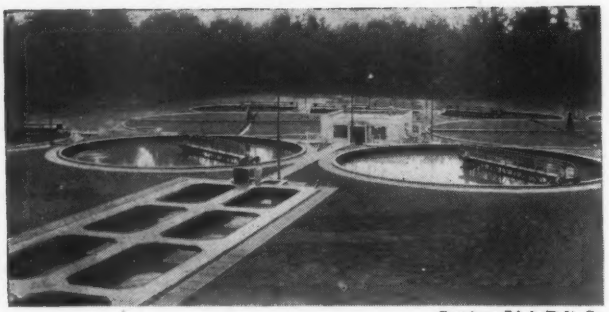
The B.O.D. loading on the filters is 2.865 pounds per cubic yard on the basis of the B.O.D. of the raw sewage.

The final settling tanks provide a detention period of 3.25 hours.

Analyses of sewage are made daily. Results of analyses are reported as follows:

	Raw Sewage	*Primary Effluent*	*Secondary Effluent*	*Final Effluent*
B. O. D.	228	93	25	10
Suspended Solids	312	74	22	9
pH	7.3	—	—	7.1

Sludge average, 4,200 gallons per million gallons of sewage; moisture content was not reported. Gas production averaged 1.0 cubic feet per person per



Courtesy Link-Belt Co.

Part of the Fort Bragg plant. Coagulation tanks in foreground; in center, two of the settling tanks with Circuline sludge collectors; a biofilter on each side of pump house.

day. Supernatant is returned to the primary distribution manhole and has produced no noticeable effect on operation. Few filter flies have appeared, but when indicated the filter is flooded. Odors have been "minimum."

Camp Livingston

The average water consumption is 85 gallons per capita per day. The water as used has an alkalinity, as $CaCO_3$, of 170 p.p.m., and a hardness of O.

Average sewage flow is 85 gallons per capita per day, including an approximate 4.2 gallons per capita of laundry waste. Peak flows do not appear to exceed 150% of average flows, while the minimum flow, which occurs at 4 A.M. is approximately 40% of the average. The average B.O.D. per person per day is 0.1366 pound.

The Camp Livingston plant is a two-stage biofilter and consists of a comminutor, two circular clarifiers, two primary filters, one secondary filter, one final clarifier, and two digesters, the primary digester being heated. Alkalinity of sludge in primary digester was 1980 p.p.m., and in secondary digester, 2400 p.p.m.

Based on a recirculation ratio of about 1.2:1, the retention period in the primary clarifiers is 1.8 hours, and in the final clarifier it is 1.44 hours.

The loading on the filters, based on raw sewage B.O.D., is 2.5 pounds per cubic yard of stone in both primary and secondary filters.

Analyses of the sewage are made as follows, the samples being composited hourly in proportion to the flow: Plant influent and effluent, 8 A.M. to 7 A.M. and analyzed daily; primary clarifier effluent, primary filter effluent and secondary filter effluent, 8 A.M. to 2 P.M. and analyzed twice a month. Results are:

	Raw Sewage	*Primary Effluent*	*Secondary Effluent*	*Final Effluent*
B.O.D.	193	113	67	26
Suspended Solids	217	62	41	24
pH	7.1	7.5	7.6	7.6

Sludge averaged 7,820 gallons per million gallons of sewage, and had a moisture content of 95.2%; volatile matter averaged 68%; gas production was 1.18 cubic feet per person per day. Supernatant was returned to the well where raw and recirculated flows are mixed. It had no noticeable effect on operation. Occasional odor troubles occurred which were controlled by prechlorination. Filter flies were also controlled by high chlorine application at minimum flows.

Fort Bragg

Average water consumption is 78.3 gallons per capita per day. The treated water has 14.0 p.p.m. of alkalinity as $CaCO_3$, and a soap consuming power (as $CaCO_3$) of 34.5.

Average sewage flow is 64 gallons per capita per day, including an approximate 4.1 gallons per capita of laundry waste. Average B.O.D. per person per day is 0.1813 pound. Hourly flow rates from 9 A.M. to 8 P.M., on the basis of per capita per day flows are:

9 A. M.	120	3 P. M.	105
10 A. M.	120	4 P. M.	100
11 A. M.	110	5 P. M.	100
12 Noon	72	6 P. M.	84
1 P. M.	84	7 P. M.	92
2 P. M.	93	8 P. M.	96

A fairly high rate of flow is maintained until midnight.

Sewage analyses from hourly composites according to flow are as follows:

	Raw Sewage	*Primary Effluent*	*Filter Effluent*	*Final Effluent*
B.O.D.	340	167	87	43
Suspended Solids	245	108	170	47

An average of 16,400 gallons of sludge per million gallons of sewage is reported, the moisture content averaging 95%. Supernatant is returned to the primary tanks, affecting them very slightly. Gas production is 0.94 cubic foot per capita per day.

On the basis of average results for the month of January, 1942, the B.O.D. load, based on raw sewage strength, was 3.2 pounds per cu. yd. of filter stone.

Camp Wallace

The average sewage flow at Camp Wallace and the composition of the sewage have varied as follows:

		B. O. D.				
Month	*Gals/cap/day*	*Raw*	*Primary Effluent*	*Final*	*Suspended Raw*	*Solids Final*
Sept.	—	186	—	20	215	17
Oct.	117	149	65	12	228	18
Nov.	95	223	127	25	236	36
Dec.	68	288	175	38	322	51

Daily B.O.D. production per man has been as follows: Oct., 0.1448 pound; November, 0.1765; December, 0.1632.

This is a 2-stage biofilter. The primary treatment is provided by a Clarigester which gives a detention period of about 4 hours; however, this is not constant, since the recirculation ratio varies from 1 effluent to 2 raw, to 3 or 4 effluent to 1 raw. Secondary settling units have the same capacity as primary units.

The loading on the filters, on the basis of the raw sewage B.O.D., varies from month to month, from 4.1 pounds to 4.6 pounds per cubic yard.

Camp Wolters

The sewage treatment plant at Camp Wolters is a 2-stage biofilter, consisting of screens, 2 primary clarifiers, 2 biofilters, 2 secondary clarifiers, primary and secondary digesters, etc. Volume and composition of the sewage are as follows:

		B. O. D.				
Month	*Gals/cap/day*	*Raw*	*Primary Effluent*	*Final Effluent*	*Suspended Raw*	*Solids Final*
Oct.	83	240	163	44	196	26
Nov.	74	292	197	75	171	37
Dec.	72	312	197	90	193	52
Jan.	—	—	—	—	—	—
Feb.	78	275	209	82	193	51

Analyses have shown the grease content of the sewage to be: October, five analyses, 100 p.p.m.; November, four analyses, 79 p.p.m.; December, five analyses, 109 p.p.m. B.O.D. per capita per day are reported as follows: Oct., 0.166 pound; Nov., 0.180 pound; Dec., 0.1874 pound; and Feb., 0.1788 pound.

Tests on raw sewage at the time supernatant is being returned show a B.O.D. of 450 and suspended solids of 400. Tests on the supernatant return, of which some 20 have been made, show that the centri-

(Continued on page 24)

How Brownwood, Texas, Handled Its Preparedness Boom

By RUEL McDANIEL
Based on an interview with Wendell Mayes, Mayor of Brownwood, Texas

With the population doubled in two weeks and tripled in six months, the city had a big problem in sanitation, traffic and revenue.

MANY things happen quickly and unexpectedly when a town finds itself the center of a sudden preparedness boom. In view of the fact that these booms are hitting many cities and towns throughout the United States, and many more are due for the immediate future because of our expanded program for defense, what one typical preparedness boom-town—Brownwood, Texas—did to meet its multiple problems should prove of practical value to other municipalities who will be faced with the same problems later.

Brownwood's 1940 population was 13,398, and there had been no material change in this figure up to October 12, 1941. On that date the first dirt was turned for the construction of nearby Camp Bowie. Within two weeks after the initial construction work began, the city's population was practically doubled. At one time, more than 17,000 men were employed on the project. Nearly half that number additional lived in or near Brownwood waiting to go to work. It is estimated that the population of Brownwood and the immediate vicinity at the height of the construction boom was nearly 40,000.

The construction work, so far as the major units were concerned, lasted about six months, or until around April 1, 1941. Then construction workers began moving out then, and some 30,000 soldiers moved in, many of them bringing families or dependents. Even though the major construction is finished, the present civilian population of Brownwood is estimated at above 25,000.

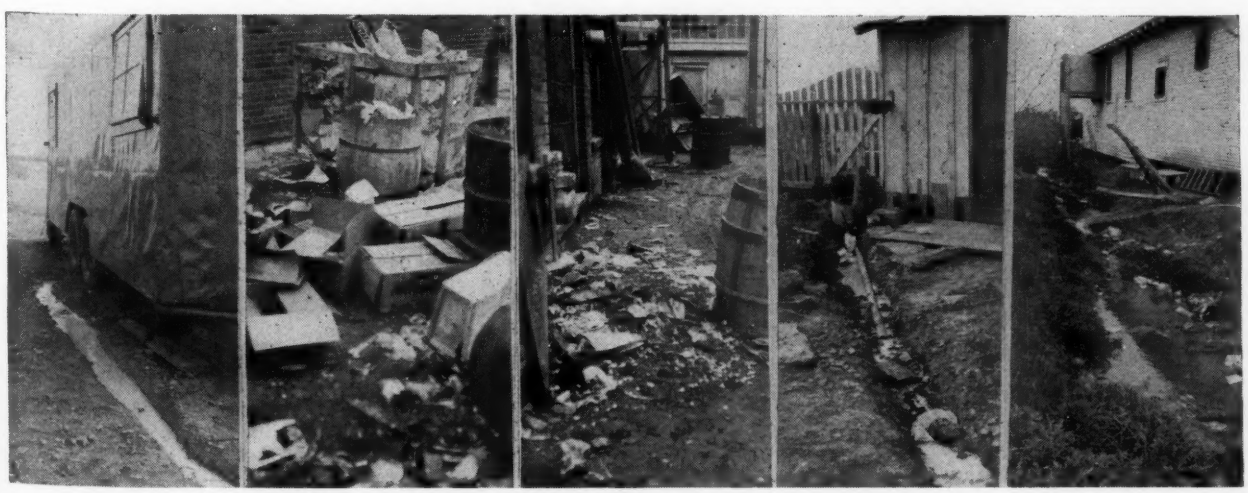
Sanitation was the first major problem confronting the city. Overnight, vacant lots, non-regulated tourist camps and roadsides were cluttered up with the trailers and tents of the transients. Practically all these trailer and tent camps and vacant lots were without any sort of sanitary conveniences and before anyone realized it, the situation was acute.

The city commission hurriedly considered the situation and obtained the services of a city-county health unit. The first step was a systematic clean-up campaign. In this, the mayor and the commissioners did something unusual and especially effective—they asked the local Business and Professional Women's Club to take over the clean-up campaign; and the president of the organization assumed direct charge of the drive, under the supervision of the city administration.

As a part of the program, the city began cleaning the streets. A local newspaper co-operated by running a series of pictures showing health hazards in the city, and citizens reported other sanitary hazards within the city, to either the chairman of the women's drive or the mayor. The city commission dug up and enforced an old ordinance, which required merchants to maintain metal containers with lids for garbage and waste from their premises. When members of the women's club found unsanitary conditions, they notified the property owners or other offenders to rectify the situation within five days, and the names of offenders who did not do so were turned over to the law enforcement authorities.

The city-county health unit was of special help to

(Continued on page 40)



Some of the conditions Brownwood remedied in its clean-up campaign

Result of absence of proper drainage of a golf course

Drainage ec

Why drainage is necessary for golf courses, tennis courts, baseball and football fields, running tracks and playgrounds, and how to secure it by proper construction.

NOT since World War I have the health, strength and aggressiveness of our young men been so important to the nation as at present. That United States youth excel in these qualities is due largely to their athletic training. Football has developed aggressiveness, baseball teaches team work, and bulldog determination to continue after further struggle seems impossible is a part of track work.

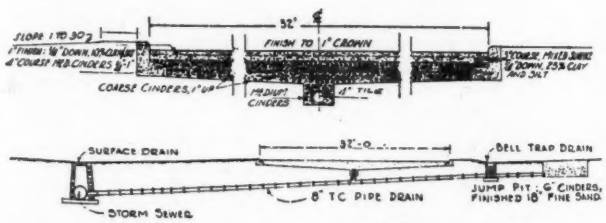
Such training has been obtained on public, school and college recreation grounds. Unfortunately the use of these grounds is often limited by lack of proper drainage, so that during rainy seasons their "availability factor" is low. Maximum availability and minimum maintenance cost are dependent largely on proper drainage; and this, fortunately, can be obtained by use of common labor and materials not in demand for war production.

General Principles of Drainage.—In a broad sense, the same principles apply as in airport or highway drainage. The surface water must be removed, and a system of subsurface underdrains installed to lower the water table and provide a firm surface. The depth, spacing and location of the drains depend upon the type of soil primarily. Construction normally consists of strong, durable drains, laid carefully and truly to line and grade; surrounded with a relatively fine porous material, such as broken stone or gravel that will pass a 1-inch screen; and with a free outlet. Care and attention is necessary to secure a good job, and good materials should be used. For drain pipe it is good practice, and good insurance also, to follow A.S.T.M. specifications and use only products that will give long service under severe conditions of use. Ordinary farm tile should not be used, but the extra quality covered by A.S.T.M. specification C 4-24. Replacement of subsurface structures is costly and troublesome; therefore original construction should be designed for long, effective and trouble-free service.

Golf Courses.—Subsurface drainage is essential for a good turf. As a result of tramping by players; the operation of mowers, trucks and other equipment; and the constant work to elminate worms, grubs and burrowing animals, golf course soils are usually tightly packed. Without good drainage an excess of water remains in the soil and tends to seal it against air. Puddles after rain not only interfere with playing, but also cause poor patches of turf. Proper drainage aids greatly in the maintenance of good growths on fairways and greens.

Drainage also permits earlier play in the spring, use more quickly after a rain and less damage from wet weather use. These are important factors in a public course, where income results directly from use; consequently, playability immediately after a rain may be an important factor financially.

The best time to determine specific needs for drainage is in the spring when the course is still wet from spring rains or from thawing snow. Complete drainage of all fairways may or may not be needed, though it is often or usually desirable for the reasons already mentioned. The greenskeeper or other personnel responsible for the condition of the course should make notes of the conditions of the various areas in both wet and dry weather. Such notes will provide an excellent long-time guide for the sections needing attention.



Drainage of cinder running track (top) and jumping pit (bottom)

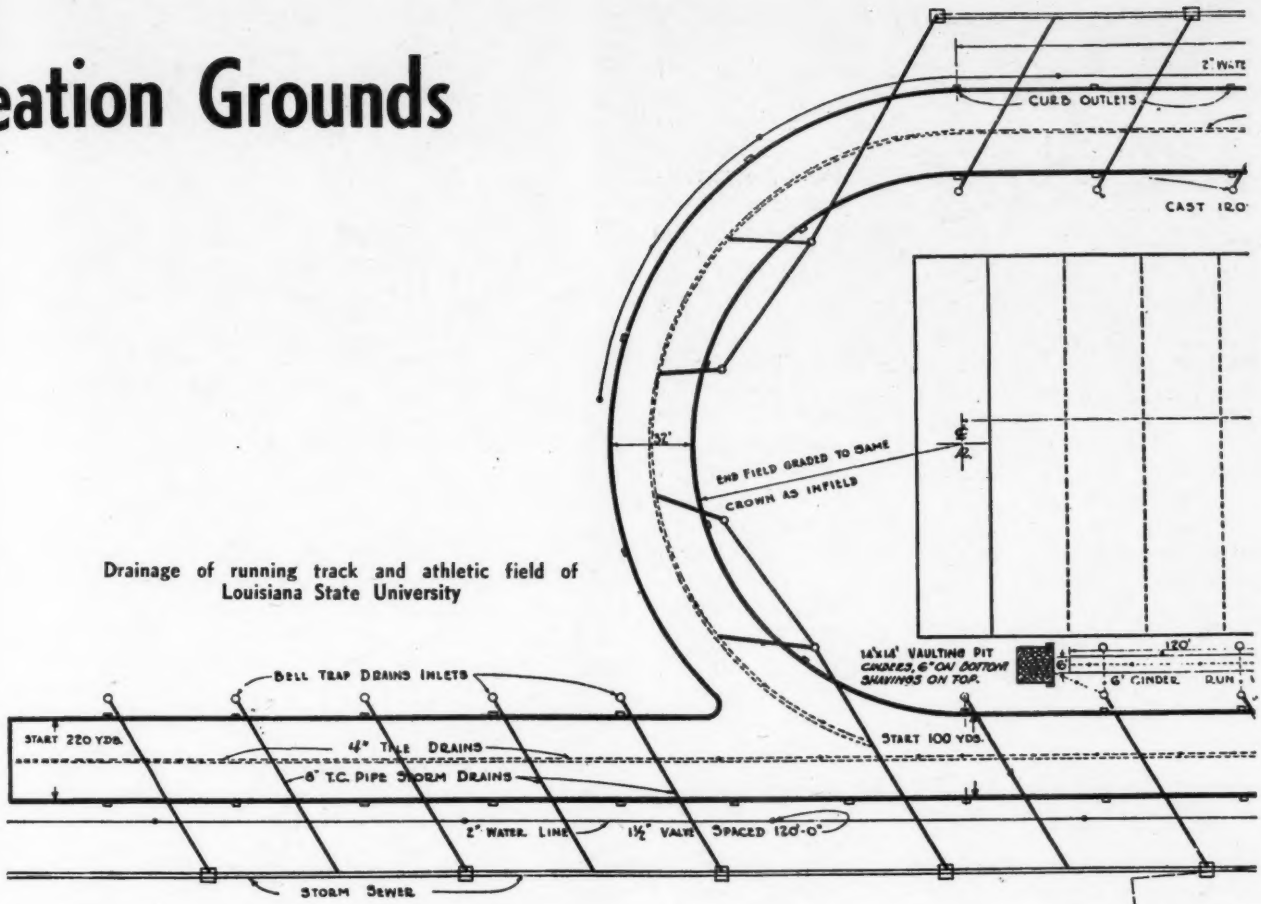
Depending on local conditions and soil characteristics, subsurface drains in fairways should be spaced 20 to 100 feet apart. Normally a depth to the invert of the tile of about 2½ or 3 ft. will be sufficient. The bottom of the trench should be shaped to receive the tile; or, about 3 ins. of broken stone or gravel (1-inch or smaller) should be used as a bedding course. Stone of the same size should be placed around the drain and from 12 to 16 inches over it.

Subdrains are essential on greens if the turf is to be kept in good condition. For most cases, a spacing between 15 and 25 feet will be suitable. For this work, the most careful construction and the best materials are essential.

In all cases, the drains should be brought to a free outlet. Junctions should be made carefully with factory-made fittings or by small brick or concrete boxes, in order to preserve the grade and prevent clogging.

Baseball Fields.—Both surface and subsurface drainage are necessary for the diamond, and, unless the soil is very open and porous, subsurface drainage will be needed in the outfield. The pitcher's mound is built about 10 inches higher than the rest of the infield, with uniform slopes to all of the bases. This constitutes the necessary surface drainage. Depending on the soil, the

ecreation Grounds



Drainage of running track and athletic field of Louisiana State University

subdrainage for the infield should consist of tile lines laid 10 to 20 feet apart. If the soil is especially heavy, it is desirable to remove it to a depth of 12 ins., place 4-inch drains 15 feet on centers in trenches about 8 ins. deep, place a course of cinders 3 or 4 inches deep over the entire infield and cover with a mixture of clay, silt and sand. A little experimenting with various mixtures of these materials will indicate which will give the best results. A grass infield with skinned base lines is usually best. The outfield should be subdrained, but the width and character of the drains will depend on the soil; 4-inch drains, about 16 inches deep, backfilled with porous material, and spaced 35 to 50 ft., will usually be satisfactory. For both infield and outfield, the subsurface drains should discharge into a storm drain at a point well away from the playing field.

Football Fields.—Both surface and subsurface drainage should be provided. The playing surface should be sloped to the edges, the slope being about 2½ ins. Underdrain spacing, as in all other cases, depends on the soil; 20 to 50 ft. will normally be adequate. These should be laid about 16 ins. deep in trenches backfilled with porous material and should connect to an outlet drain at either or, preferably, both sides. This should be located well away from the sideline.

A well graded and drained golf course

Running Tracks.—Tracks are usually constructed with a cinder base (see PUBLIC WORKS, Dec., 1938) and a surface of clay, silt and cinders. Under the center of the track should be placed a 4-in. or 6-in. subdrain surrounded with cinder or gravel. This should have an appreciable slope to outlets. The track itself should have about a 1-inch crown to facilitate runoff.

In connection with a track, provision is usually made for pole vaulting and high and broad jumping. For the former, sand pits should be about 14 ft. square; for broad jumping about 25 ft. long. The pits are usually constructed with about 12 or 18 inches of sand over 6 ins. of cinders. These pits should be underdrained and the drain carried to a free outlet.

Tennis Courts.—Clay tennis courts, unless underdrained, dry out very slowly; and even when dry enough to play on may have an unsatisfactory "dead" surface. Surface drainage can be accomplished by crowning or sloping the surface about 1 inch. To be satisfactory, a court should have a gravel or cinder subbase. Underneath this should be subdrains, placed in shallow trenches and backfilled with cinder, gravel or broken stone. The porous backfill should be less than 1-inch in size. Lines should be placed at about 15-ft. centers, and may drain to the center, with a collecting drain under the net, or to either end, or to the side. A center collector under the net may complicate placing the posts, and drainage to the side is therefore often preferable.

Asphalt or concrete courts need the subdrains and the porous subbase to prevent winter frost damage,

except in mild climates where drainage is naturally very good.

Financial Value of Drainage.—Many public golf courses and tennis courts derive a large part of their income from holiday or week-end crowds, which income is lost when the ground is not usable on those days; the gross income is directly affected by the "availability factor." Subsurface drainage may not prevent all losses from this cause, but it will minimize them. "Wet Grounds" cause many baseball postponements. Football games are usually played, irrespective of the weather, but a well-drained field is an important element. Track meets are usually end-of-the-week events that cannot be postponed and are a total loss if cancelled. Regardless of rules, players will use greens and fairways before they are past the soggy stage, causing excessive maintenance costs. Playgrounds at schools must be well-drained to prevent complaint on the part of parents.

The advantages of public recreation grounds cannot all be translated into definite money values, but such values are even more important than financial ones and are proportional to the availability factor. Adequate drainage adds to their utility and usefulness, and engineers have definite responsibilities in this field for helping to develop the physical and moral health of the nation.

Street Maintenance Practices

(Continued from page 15)

Biery, city engineer, bases practice on percentage of patching required, but has no fixed percentage.

In Minnesota, a number of city engineers use the amount of spring break-up damage as a criterion, or the number of frost boils per block. Frank O. Jones, city engineer, Fairmont, Minn., says "When over 25% needs patching, the entire surface is replaced or, if feasible, the old material remixed and relaid." F. T. Paul, city engineer, Minneapolis, Minn., resurfaces when maintenance and repairs reach 7 cents per sq. yd. per year. Rochester, Minn., A. C. Smith, city engineer, resurfaces when 20% of the area of the surface is bad. H. R. Covington, city engineer, Canton, Miss., says "if the surface is worn uniformly, we resurface; if the base is spotted or bad, we patch or rebuild." Everett C. Meyers, city engineer, Maplewood, Mo., compares the cost of satisfactory patching with that of surfacing.

Charles A. Hausser, borough engineer, Madison, N. J., considers, first, the budget appropriation; second, the amount of patching and general condition of the surface; and, third, the relative costs. In Metuchen, N. J., W. F. Buchanan, borough engineer, considers frequency of failed sections, imperviousness of surface, and the original design. In Somerville, N. J., E. S. Van Fleet, borough engineer, if a street requires extensive repatching, it is also surface treated.

Brooklyn, N. Y., Arthur J. Griffin, chief engineer, considers condition of foundation, amount of maintenance and age of pavement. In Fulton, N. Y., Harry S. Andrews, city engineer, patches if the estimated cost of doing so is less than the total annual amortized cost of resurfacing. C. J. Strandburg, city engineer of Jamestown, N. Y., resurfaces if more than 20% of the total surface area is bad. J. C. Adams, village engineer, Johnson City, N. Y., uses 30% of the area as a criterion. Leo Wall, city engineer, Miamisburg, O., resurfaces when the street surface shows signs of absorbing moisture. In Abington, Pa., Oliver L. King, township engineer, considers appearance, age and original type of construction. Harry C. McCrea, borough manager, Blairsville, Pa., resurfaces when approximately 20% of the surface is bad. The borough of Sayre, Pa., Harry C. Childs, engineer, also uses the per cent of the area of the surface (what per cent, Mr. Child?).

Brooks Hawkins, superintendent of highways, Barrington, Conn., considers the following: Costs of patching and of resurfacing; amount of traffic carried; funds available; and future utility construction. (It would be interesting to have details on this—Ed.) In Rosebud, Tex., M. A. Mayer, water superintendent, resurfaces when 30% of the street surface needs attention. According to N. E. Trostle, water superintendent and city engineer, Temple, Tex., streets are resurfaced "after a sufficient number become over 50% patched to permit resurfacing several blocks at a time."

W. D. Beers, city engineer, Salt Lake City, Utah, patches if the area needing repairs does not exceed 20% of the surface, otherwise the surface is scarified, gravel added and rolled and oil and stone chips applied. E. C. Boyden, municipal manager, Middlebury, Vt., states: "If 1/3 or more of the surface is to be repaired, we resurface." In Vinton, Va., according to H. W. Coleman, town manager, if 25% of the surface needs repairs, it is resurfaced.

W. A. Collins, superintendent of public works, Beloit, Wis., bases his decision on "nature of patches required, size, depth into subgrade, condition of remainder of pavement, cracks, ridges, etc." (We should be glad to have Mr. Collins discuss this more fully and definitely.—Ed.) In Sparta, Wis., Jack D. Markham, city engineer, if 50% or less of the surface is damaged, the street is patched.

Several hundred other city engineers replied to this question. The above replies have been selected to illustrate general practices in different parts of the country and, so far as possible, to give definite information on the practices followed. Comments of a helpful nature, in sufficient detail to be of definite value to others, will be welcome.

Operating Results on Five Army Biofilter Plants

(Continued from page 20)

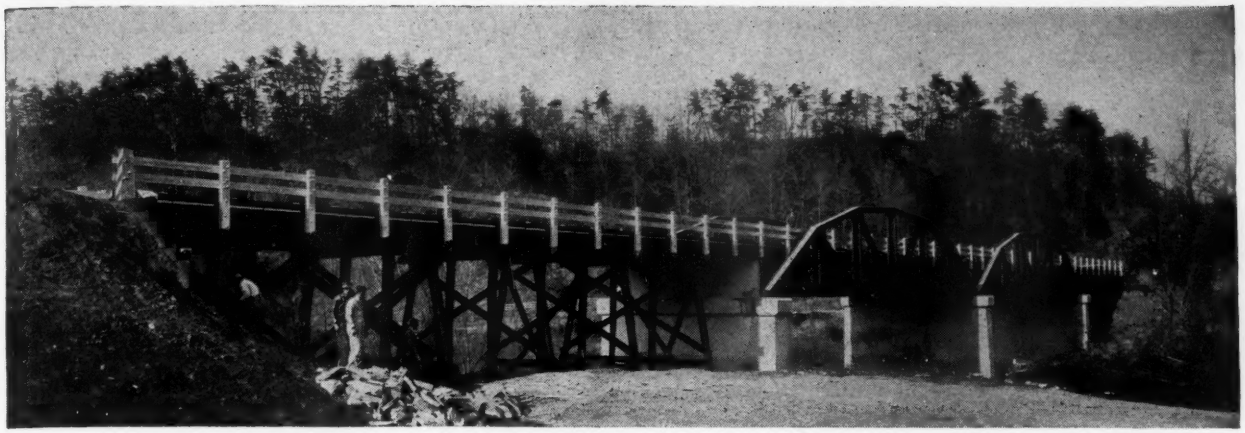
fuged solids average 16%, the suspended solids 2.5% and the volatile solids 51%. The sludge amounts to about 9400 gals. per million gallons of sewage.

Approximately 6 hours detention is provided in the primary tanks on the basis of the raw sewage flow, and approximately 7¼ hours in the secondary settling tanks. Recirculation and, consequently, the detention period, has varied. Recirculation to the primary tank ranges from 1 to 1½ times the raw sewage flow; and to the secondary filter about 1 to 1.

The loading on the filters varies from 3.3 to 4.25 pounds of B.O.D. per cubic yard of stone, based on raw sewage strength without allowance for supernatant.

Feeding Calgon Through a Dry Feeder

Charles Spaulding, chemist at the Springfield, Ill., water works, was told that Calgon could not be fed through a dry feeder; so he proceeded to prove the contrary. Mixing Calgon with soda ash and grinding the mixture, he has no difficulty in obtaining accurately the dose for which the dry feeder is set.



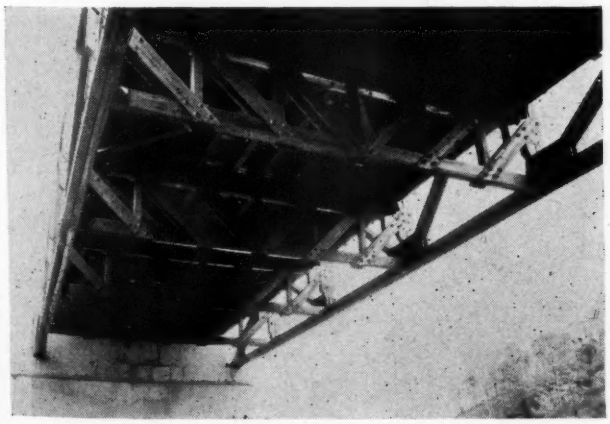
The Crabbe Road bridge, constructed of timber with the use of connectors

Scientific Use of Wood in Structures

With the present scarcity of steel for non-war use, wood must be used much more generally. How connectors aid in this.

In a recent issue we referred to the desirability, perhaps necessity, of using wood in many structures where metal has commonly been used in the past, and to the recent development of methods and devices which enable us to improve over the practices of our ancestors. They had abundance of lumber in large sizes that are not now readily available; they knew little about unit strengths or calculation of stresses—they just used pieces they felt sure were large enough. Using timber cut on the spot and squared by hand, a 12 x 12 might be cheaper than a 12 x 6.

Timber has always been used much less commonly in Europe than in the United States, but after World War I metal was scarce over there and attention was given to wood; but that also was scarce, especially in the large sizes, and their engineers, studying how it could be used most economically, developed more scientific principles of use, among them what are known as connectors. In 1933 the Committee on Wood Utilization of the U. S. Department of Commerce brought to the attention of engineers in this country the idea of connectors developed in Europe, and they have been used in many structures in this country.



View of under side of Crabbe Road bridge, showing construction of trusses

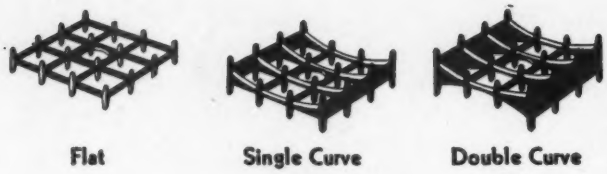
Meantime an intensive study was being made of timber and its uses by the Forest Service of the United States Department of Agriculture, in the Forest Products Laboratory at Madison, Wis.

Thus there now is available abundant information permitting scientific, economical and effective use of timber, in easily obtainable stock sizes from 2 x 4 to 3 x 12, for almost any kind of structure desired.

The connectors referred to are metal devices employed in the contact faces of lapped members to transfer load from one member to another, the members being held together at the joint by a bolt or bolts. These devices present a large bearing area against the wood near its surface normal to the load applied, as compared to the much smaller area of a bolt, thus transmitting a much heavier load without crushing the fibres than is possible with an ordinary joint, even where several bolts are used. The use of these not only permits utilizing a higher percentage of the working stress of the timbers, but facilitates use of structural timber of small dimensions and greatly simplifies the framing of joints.

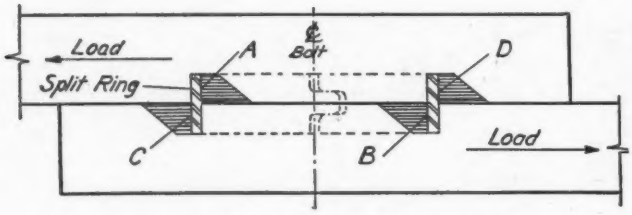
Connectors take several shapes; the most common are in the form of rings that are set with half their width in each of two faces in contact; or a number of double-pointed spikes joined together in a grid, placed between the two faces that are to be in contact and forced into both of them by pressure. The use of these has been placed on a scientific basis, allowable loads both with, and at different angles to, the grain of the wood, for different thicknesses of wood and different sizes and types of connectors, having been calculated from the thousands of tests made by the Forest Products Laboratory on all of the varieties of wood in common structural use in this country. Tables giving safe loads and other data can be obtained from the National Lumber Manufacturers Association, Washington, D. C.

An illustration of the use of connectors in timber construction is offered by the Crabbe Road bridge across the North River near Tuscaloosa, Alabama, recently opened to traffic by the County Board of



Spike Grids

Split Ring Toothed Ring



Bearing Surfaces for Split Ring Connectors

Revenue. This bridge is 333.5 ft. long, with a 24-ft. roadway, designed for an H-15 loading. It cost $43,000, including three concrete piers, or $5.36 per square foot of roadway.

It was designed by Donald A. du Plantier, associate professor of structural engineering, College of Engineering, University of Alabama, for fabrication by the Teco system of engineered timber construction, and was fabricated and erected by WPA labor under the direction of Powell Baker, WPA engineer.

The approaches are supported by trestles of 15-foot span, six on the south side and four on the north, with 12″ x 12″ trestle caps. The channel span is composed of two identical pairs of 90-foot span, half-through trusses, 15 feet deep. End posts are 6″ x 14″; chords, 6″ x 12″; diagonals, 6″ x 8″, and verticals, 8″ x 10″ with the ten-inch dimension placed transverse to the bridge axis to stiffen the top chord for half-through construction. Joints are connected by Teco 4-inch shear plates and split rings, flat spiked grids and single curved spiked grids. Each main truss joint has four ⅜″ steel gusset plates, two outer and two inner.

Floor trusses have 8″ x 12″ chords, 6″ x 8″ verticals, and 2″ x 12″ diagonals in pairs. Lateral bracing is of the "K" type with 3″ x 8″ timbers and steel gussets welded to the main gussets.

Stringers are 6″ x 16″, 15-foot span, placed 30 inches on centers. Toenailed to the 4″ x 10″ subflooring is 2″ x 2″ laminated gum, surface flooring.

All timber was creosoted. In the piling, a 16-pound full-cell treatment was employed and, for the other wood, an 8-pound open-cell treatment.

In designing the bridge, Prof. du Plantier took advantage of the technical data and typical Teco designs offered to engineers by the Timber Engineering Company, Washington, D. C. He also had available the advisory services of the regional distributors, Maxwell & Hitchcock, Atlanta.

Wood Preservatives

Wood is one of the few structural materials not included in the rapidly increasing list of essential and difficult-to-obtain materials. It possesses several advantages, such as resiliency, low heat conductivity, ease of fabrication and low initial cost; but in durability it is inferior to steel under some conditions. Where the structure is not of a permanent or semi-permanent nature this may not be important. But where it is important, the resistance of wood to rot, attack by insects or fire can be greatly increased by proper chemical treatment.

There are two general classes of preservatives—oils and toxic salts. Of the former, creosote is the most commonly used; railroad ties, piles and dock timbers, and poles used by the utilities are generally creosoted and their lives thereby increased many-fold. The odor of creosoted timber, its dark color and the difficulty of painting are objections in many structures, and here the salts can be used. The most commonly used salt is chromated zinc chloride. Wood treated by it is well adapted to use in buildings. It is odorless, clean, is easily worked and takes paint readily. It can be made to penetrate the wood throughout and protect it from termites. For impregnating with this salt, the lumber is placed in huge, hermetically sealed cylinders, the preservative is introduced in liquid form, and pressure is applied until the wood is completely penetrated. Wood so treated is poisonous to decay-producing fungi and does not burn readily.

Sewerage and Treatment in the United States

On the basis of a nationwide census of the sewerage systems of all communities in the country, recently completed by the United States Public Health Service, it is estimated that 95 per cent of the urban population of the country is served by public sewer systems. Of these systems about 91 per cent are publicly owned. With regard to methods of sewage disposal, 58 per cent of the population connected to sewer systems is served by sewage treatment of all kinds, and the remaining 42 per cent by no treatment. Of the total population served by treatment, nearly one-half is served by primary treatment plants and a little over one-half by some form of secondary treatment. Under primary treatments, separate tank treatment serves 58 per cent, Imhoff tanks 33 per cent, and septic tanks the remaining 9 per cent. Under secondary treatment, the activated sludge and trickling filter methods predominate, the former serving 47 per cent and the latter 38 per cent, or a total of 85 per cent of the population served by secondary treatment. About 97 per cent of the total treatment plants provide sludge digestion, and 63 per cent of all treatment plants have some sort of sludge dewatering and disposal. In some states, notably Illinois, Maryland, Minnesota, Texas and Wisconsin, the proportion of the total sewered population now served by treatment is extremely high, approaching 90 per cent or more.

New Solder Composition to Conserve Tin

As soon as it became apparent that there would be a serious shortage of tin, A.S.T.M. subcommittee B-2 developed emergency specifications covering new grades of solder and babbitt metal to conserve the amount of tin used. Specifications should be changed to provide for use of these emergency grades instead of those heretofore commonly required.

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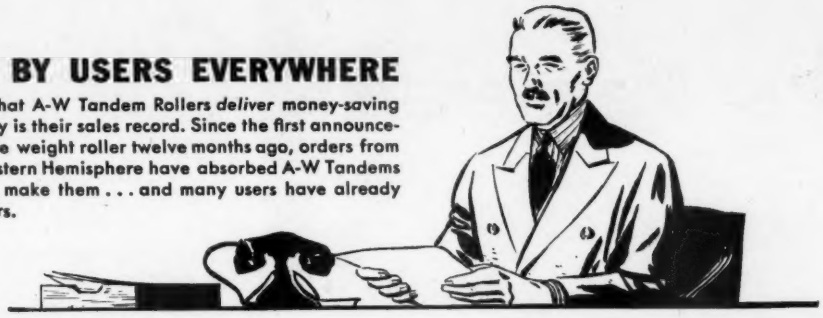

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

Filter Maintenance at the Griffin, Ga. Water Works

By LEWIS R. SIMONTON
Superintendent of Filtration, Griffin, Ga.

Night view of building housing Griffin's plant

THE usual rapid sand filter is designed to operate at the rate of 125 million gallons per acre per day, or 2 gallons per square foot per minute. If a filter is kept in good condition, this rate may be exceeded for short periods without impairing the quality of the effluent, which should not exceed 0.2 ppm turbidity. Under operating practice at Griffin we have found that, when the loss of head exceeds 6½ feet, the filter will begin to pass coagulated matter and the bacteria count will increase from the usual count of 3—10 to 35—50. Therefore we have adopted the practice of washing the filters when the loss of head reaches 6 feet. By this practice, and with proper maintenance, we are able to produce an excellent effluent at all times.

Constant rate of filtration is maintained by controllers which automatically open to a wide position as the loss of head increases. Our rate-of-flow controllers are checked periodically by closing the influent valve and noting with a stop watch the time required for the water level to drop six inches. Knowing the filter dimensions, it is easy to calculate the rate of flow per 24 hours. After this check has been made it may be necessary to adjust the indicators to correspond with this rate of flow.

I recommend almost any type of surface wash in conjunction with the usual filter wash. Not having the Baylis surface wash nor the Palmer filter sweep, we handle our filter washing in this manner: After first closing the influent valve, the water level is drawn down to six inches above the sand. The remaining portion is then filtered down to a few inches below the sand level through the rewash valve. Then the surface of the sand is hosed well by an operator standing in the washwater trough. The dirtiest portion of our filters being the top six inches, this hosing breaks up any small mudballs that may begin to form. These, if left unnoticed, will eventually become larger and larger and finally settle between the gravel and sand layer. We have also found that this hosing keeps the sand grains from becoming coated with a gelatinous film; if this is not removed the sand will become lighter and finally we will begin to lose some of the sand over the wash water trough during washing.

After this surface wash, the wash water valve is opened slowly until it reaches its wide open position, at which position we are getting a sand expansion of 40%. The volume of water used during washing is 6,000 gallons per minute. The washing period is from 4 to 5 minutes, depending upon the clarity of the final wash water as it passes into the drain troughs. The yearly average of wash water used will not run over 1.5%. Another point that I would like to bring out is that you should not always wash at a fixed rate. By this I mean that an increased sand expansion and a more efficient wash is obtained with cold water than with warm water. Therefore, an efficient wash during winter months will be an inadequate wash during the summer months.

I have found by experience that, even though a water is pretreated effectively and the wash water is adequate, the filters will need attention. The sand, in even the best operated filters, will become dirty over a period of time, and I wish to stress this part of filter maintenance. Filter sand may be cleaned by two methods: The removal of the sand by ejectors and cleaning with sand washers; or by chemical treatment. We use the chemical treatment, with caustic soda and chlorine.

First the filter is given a good wash. Then all the water is drawn down through the sand bed to waste. The next step is to scrape off the top layer of sand to a depth of one-eighth of an inch. This scraping removes the gelatinous coating of accumulated carbon and floc particles that is very difficult to remove by the ordinary filter wash. After scraping, the filter is again washed and the water is drawn down to about 10 inches above the sand level. We are now ready for our caustic soda, which is scattered over the filter by the use of a shovel. Two hundred pounds of caustic is used to each filter unit (20 feet wide and 18 feet long). A man stands in the wash-water trough and by the use of a long-prong rake picks up the sand bed to a depth of 6 to 8 inches. After picking up the bed, the caustic solution is drawn down into the filter until it is even with the top of the sand. The raking is repeated every two hours for at least 10 or 12 hours. Then the remaining portion of the caustic solution is drawn out slowly over a period of several hours by cracking the rewash valve. The filter is again washed and agitated by rakes to remove the excess caustic solution.

The next step is to apply a high concentration of chlorine to this filter. This is done by attaching to a cylinder of chlorine a ¼-inch hose, on the other end of which we attach a porous chlorine diffuser. This diffuser is placed in the forebay of the filter near the

(Continued on page 41)

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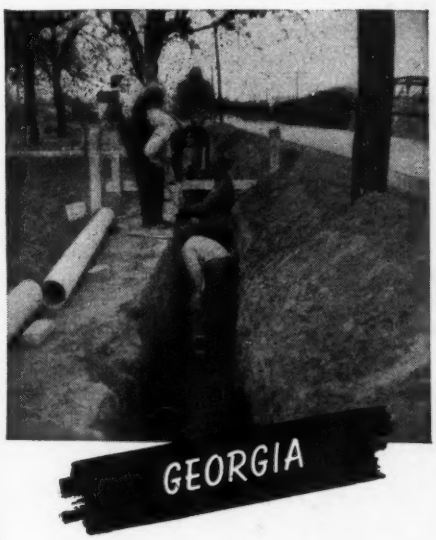

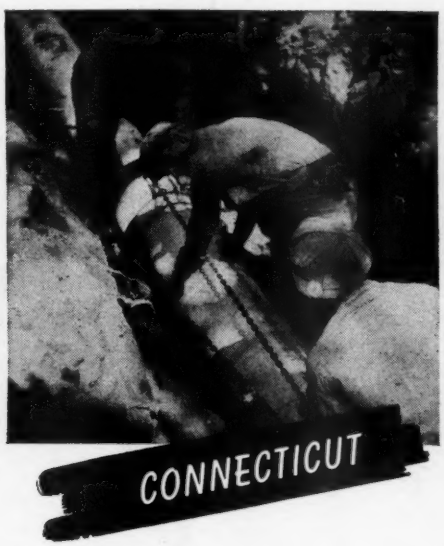

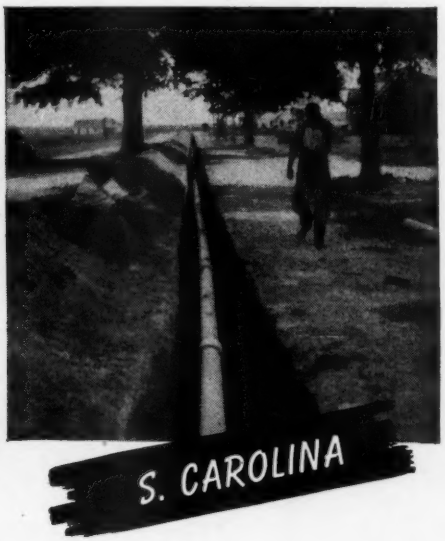

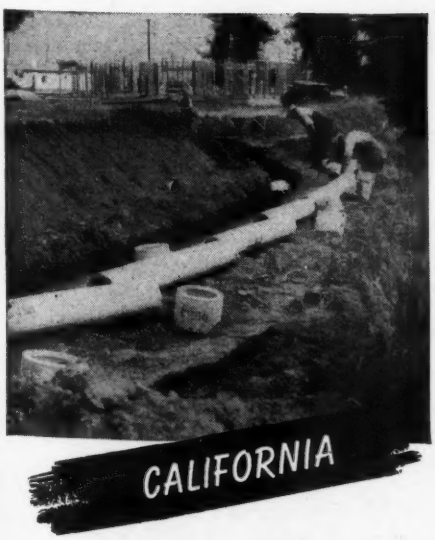

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Dangerous ditch being replaced with 60-inch pipe

Ohio Defense Highway to Reduce Accidents

A narrow main highway flanked by a deep ditch was the site of many accidents. It is now replaced with a safe four-lane surface.

ELIMINATION of a hazardous ditch on a route with a high accident record and improvement of a strategic highway for defense purposes are two objectives of the Work Projects Administration and the State Highway Department in Wood County, Ohio, in replacing a narrow and ditch-flanked section of U. S. Route 25 with a safe, four-lane highway, meeting both military needs and those of the civilian population.

Stretching for six miles along the strategically important U. S. Route 25, between the communities of Perrysburg and Bowling Green, the "Dixie Ditch," as it is known, has always presented a problem. Along this section there has always been a high incidence of serious accidents as a result of the narrow road with its paralleling wide and deep ditch. The Ohio State Highway Department recently conducted a survey of the accident history of two sections of U. S. 25 to see how an improved section compared with an unimproved portion.

The improved section, which begins at Bowling Green and extends three miles north, is a divided highway with a 4-foot flush medial island. The shoulders are 10 feet wide with well-rounded ditch and back slopes. The unimproved section is a narrow two-lane pavement with a deep drainage ditch on the west side of the highway. This section is six miles long. An antiquated guard rail only a few feet from the edge of the pavement separates moving traffic from the ditch. This road is one of the primary north-south highways in the western part of Ohio and carries an average of 5,000 vehicles per 24-hour day. The fact that 18% of these vehicles are trucks is indicative of its importance as a commercial hauling route.

During 1940, 62 reported accidents occurred on the unimproved portion of this route. An analysis of the accidents shows that there were two fatal accidents and 27 injury accidents, resulting in two fatalities and injuries to 65 persons. "Sideswipe" accidents were the most numerous of all types. Other types of accidents, in the order of their predominance, were non-collision accidents (those involving single vehicles), rear-end accidents, turning movement collisions and angle collisions. All these types of accidents can be minimized by physical facilities built into a modern highway—adequate widths, wide shoulders, ample sight distances, channelization of intersections, etc. All of these features are incorporated in the improved section north of Bowling Green. Compared to the 62 accidents that occurred on the six miles of unimproved section, there were only 5 during the same period of the improved section.

On examination of the work involved in eliminating the Dixie Ditch and providing the super-highway revealed that the best way was to carry on the work as separate projects. It was decided that the WPA should install pipe in the ditch and, upon completion of this pipe installation and the subsequent backfilling, the State Highway Department would increase the width of the present 22-foot road by another 22-foot lane. The cost of eliminating the ditch was estimated at $856,562.

Hauling all the pipe necessary for this large ditch elimination job would have meant prohibitive costs and inconvenience to traffic, so the state highway officials decided it would be more advantageous to manufacture the pipe "on location." The highway department furnished the location and plant and let the work to contracts. WPA labor was used on the plant, which was operated by Launder and Son, Inc., Toledo, Ohio, at a price of slightly more than $131,000.

Work was started on the project in April, 1940, with the initial clearing and excavating. By June the

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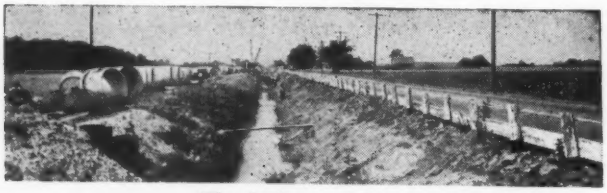

The highway as it was

And as it is now after widening

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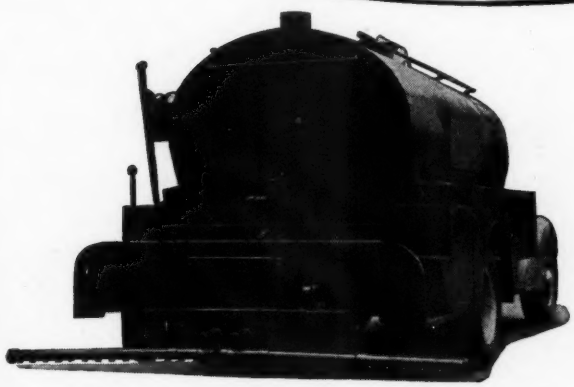

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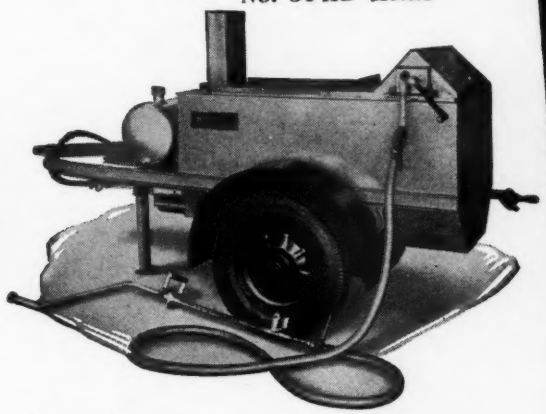
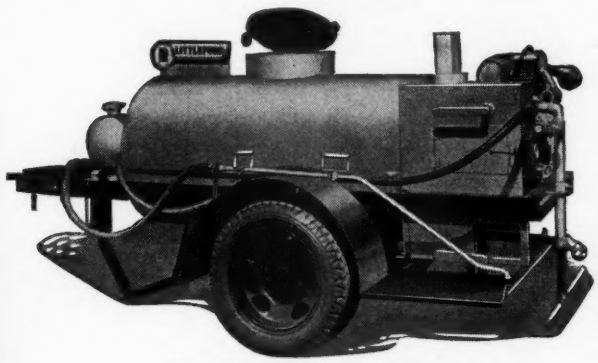
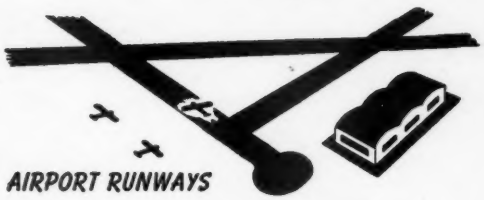




No. 101 Utility Spray Tank



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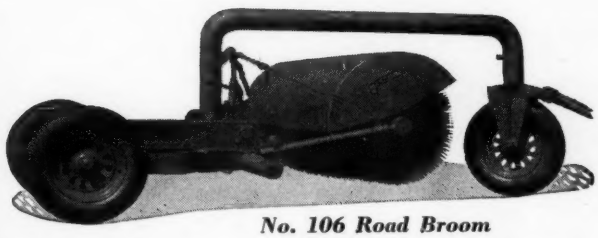
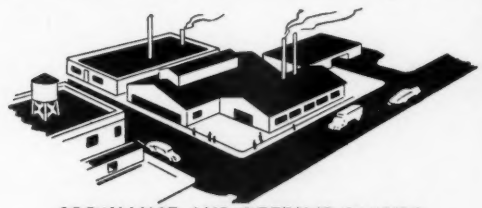


No. 106 Road Broom



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Keeping Gravel-Surfaced Roads Free from Corrugations

By E. S. RANKIN
County Highway Engineer, Crow Wing Co., Minnesota

Five conditions that cause corrugations, and remedies suggested by experiences in maintaining such roads in Minnesota

MANY types of surfaces are in use today to provide smooth-riding, mudless and dustless highways, and the problem confronting the highway engineer is how to select the type best fitted to the local traffic and conditions of climate, topography and soil, and to enable him to stay within the limitations of funds available for this purpose.

No doubt gravel surfaces will form a large part of our rural road mileage in the future as they have in the past. Here in Minnesota, as an example, of a total of some 119,183 miles of roads, 11,329 miles are in the State trunk highway system, leaving 107,854 miles of county and township roads; and in spite of the rapid increase in mileage of higher type surfaced roads during the past ten years, only a small part of this mileage can be surfaced for many years to come.

The question, then, confronting the highway engineer or road supervisor is how to keep the gravel surfaces in satisfactory condition. Corrugations and dust are the most common cause of complaints against a gravel surfaced highway. Corrugations in gravel surfaces are generally considered to be caused by the following: 1. Heavy motor vehicular traffic; 2. Poorly constructed roadbed or base; 3. Use of gravel that is improperly screened, crushed or graded; 4. Lack of proper consolidation by binder material; and 5. Lack of the use of proper maintenance equipment at the proper time and in the proper manner.

1. The factor of traffic as it relates to corrugated surfaces cannot be controlled locally other than to erect proper signs pertaining to speed and to loads, and to see that these are complied with so far as possible. On roads where the traffic is heavier than a gravel road can carry without excessive maintenance expenditures, it is poor economy to attempt to maintain it as such and the sooner a higher type of surface can be constructed the better. The amount of traffic that any gravel road surface can carry without an undue expenditure of maintenance funds is determined by the character of the subgrade, the cost of gravel applied on the road, the cost of binder soil that must be added to the gravel to form a consolidated surface, the cost of calcium chloride or other chemical applied as a moisture-absorbing agent, and the amount of surface or blade maintenance required. Against these costs must be balanced the cost of other materials necessary to change the surface from a gravel to a higher type, and the annual maintenance cost of that type.

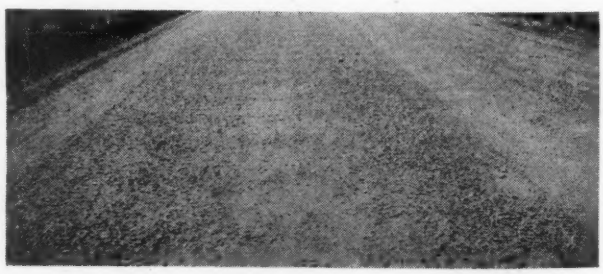
2. Poorly constructed roadbeds or bases make it almost impossible to maintain gravel surfaces smooth-riding. Inadequate drainage, frost boil conditions, and improper soils in the upper six to twelve inches of roadbed, make it more difficult to maintain a satisfactory surface.

Too much care cannot be given to drainage. If water is allowed to stand in the ditches and to soften the subgrade, no amount of good work or intentions in subsequent steps in the work will produce satisfactory service.

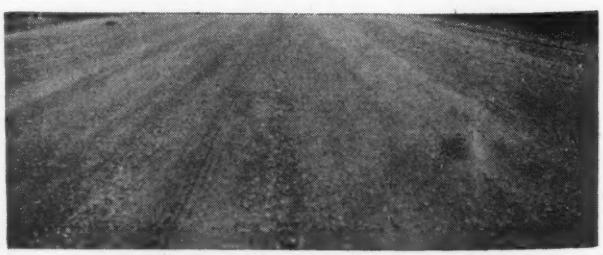
In northern latitudes, frost boils are a menace to gravel surfaces during the spring break-up. All soils

(Continued on page 39)

Showing road with too much binder soil or insufficient gravel. Note rutting of surface. Picture taken after rain with no blading. Improper consolidation of surface.



Showing road with too much gravel and insufficient binder soil. Note corrugations forming and excess gravel thrown from traveled portion of road to sides. This type of road will corrugate badly.



Showing proper stabilized and consolidated surface with correct amount of binder soil and gravel. This picture was taken following an extended rainy period and no surface blading had been done.

WATER WORKS AT WAR

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The Sixty-second Annual Meeting of the American Water Works Association is your one great chance to learn what the other fellow is doing, what the manufacturers have evolved, as the answers to *your* new war-time problems. Priorities, Bomb Damage, Guarding Property, Personnel—all these and a hundred other subjects will be presented and discussed by experts.

Nothing but grave emergency should keep waterworks superintendents and engineers from this vital Conference on War-Time Waterworks Problems. 1942 therefore becomes the year when attendance is a "must." Chicago is a most convenient and central point, and the time required cannot be better spent to your own and your communities' advantage.

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The WAR EMERGENCY
AS IT AFFECTS PUBLIC WORKS

Conserving Materials in Construction Work

The War Production Board has issued a list of materials used in war work and classified according to their scarcity. Those not generally available for civilian needs include alloy steel, iron alloys and wrought iron; aluminum and aluminum scrap; cadmium, chromium, lead, magnesium, nickel, tin, tinplate, tungsten, copper, vanadium; asbestos, burlap, graphite, jewel bearings, kapok, manila fibre and cordage, and rubber.

Materials available in some quantities include asphalt, brick and tile, cement, coal, coke, wallboard, wood, paper board, plywood.

In order to conserve steel, the amount used for reinforcing concrete should be kept at a minimum. Designs for sewers and non-pressure water conduits should be based on non-reinforced concrete, tile or brick. Walls should be designed for gravity sections, or if reinforced walls are necessary, the amount of steel should be kept at a minimum by increasing the thickness of the concrete.

Upon recommendation of the Committee on Standards of the association, the Executive Committee of the American Association of State Highway Officials, after consultation with the Federal Office of Production Management, has promulgated changes in association design and construction standards due to the necessity for the conservation of critical materials during the national emergency. The critical materials principally involved in road and bridge construction are copper, zinc (for galvanizing), steel alloys, carbon steel and other iron products.

Among the recommendations are use of reinforced concrete in place of steel in bridge guard rails, I-beams, etc. Eliminate use of aluminum paint and all galvanizing except perhaps galvanized cables and hardware in timber bridges; of all alloy steels, and of steel bearing piles (use friction piles). Make greater use of treated timber. Substitute small concrete culverts or concrete pipe in place of corrugated iron pipe culverts. Avoid addition of reinforcing steel to take compressive stresses in concrete members. Repair existing structures, if practicable, rather than replace them with new structures.

"There is need for the reduction or elimination of steel from concrete pavements and for the substitution of masonry, unreinforced concrete, or concrete or clay pipe for galvanized metal culverts.

"The use of reinforcement in concrete pavement can be eliminated by the substitution of nonreinforced slabs for reinforced slabs. When such substitution is made it will be necessary to use slab lengths consistent with the design of nonreinforced concrete slabs. In slabs with thickened edges, dowels or other low transferring devices are required at transverse joints. By substituting pavement slabs of uniform thickness for slabs with thickened edges, a reduction of steel across joints may be made inasmuch as provision for load transfer is not required, and only enough steel is necessary across joints to maintain alignment.

"The elimination of galvanized metal culverts is for the purpose of conserving zinc and iron products. As substitutes for these pipe culverts, box culverts of equivalent capacity are recommended. Such culverts may be constructed with masonry or mass concrete side walls, and with mass or lightly reinforced concrete or arched tops depending upon span and available head rooms. Concrete or clay pipe may also be used.

"Wherever possible in designs calling for reinforced concrete, substitution of miscellaneous sizes of reinforcing bars instead of design sizes is recommended, in order to utilize such local or regional stocks as may be available, making in the design such redistribution of the steel as use of the miscellaneous sizes available may require.

"In all new designs involving unavoidable reinforcing, simplification of sizes of reinforcing steel is to be secured by using only ¼", ½", ¾", 1", and 1¼" deformed rounds.

"To conserve copper, it is further recommended that lighting projects be entirely eliminated.

"It is understood that the changes in design and practice resulting from the above suggestions and recommendations, when submitted in connection with federal-aid projects, will be acceptable as emergency standards and practice wherever they are in conflict with existing association standards."

Rental Prices for Road Equipment

The Office of Price Administration has issued Maximum Price Regulation No. 134, to take effect May 11, fixing maximum rental prices that may be charged for construction and road maintenance equipment, "regardless of any contract, agreement, lease, or other obligation."

Rates are given by the day, week and month, the weekly rates being in general about four times the daily, and the monthly about twelve times. The rates are given in great detail, running into the thousands. A few of the monthly rates are given here to afford a general idea only.

Two-stage portable air compressors, gasoline engine, 210 cu. ft., $284. Blade graders, power control, 10 ft., $225. Paving mixers, full crawler traction, 27 E $750. Road rollers, three-wheel, gasoline, 8-ton, $270. Shovels, crawler type, gasoline, 1-yard, $650. Tractors, crawler, Diesel, 70 h.p. $636; with bulldozer, $756.

As a comparison, the rates for portable air compressors, gasoline, 210 cu. ft., varied from $244 in Aug. 1939 to $252 in Dec. 1941. Tractor with bulldozer, $475 in Aug. 1939 to $625 in Dec. 1941.

Equipment and Supplies for Waterworks and Sewerage

Under Preference Rating Order P-46 as amended March 26, maintenance and repair material, operating supplies and capital equipment for chlorination have an A-2 rating (not A-10 as before). This amendment allows an A-2 rating to deliveries of material required (by an agency that supplies water or public sanitation services) "for the maintenance and repair of production and pumping plant facilities, and to deliveries of operating supplies for such facilities." The use of chlorine comes under the head of "production."

An A-5 rating is granted to deliveries of "material required by him for the maintenance and repair of all other facilities, and to deliveries of operating supplies for such facilities."

The above ratings do not need prior approval by W.P.B. Such approval, however, is required for obtaining an A-5 rating for material required "for the construction of transmission, switching and distribution

facilities necessary to serve new projects (other than housing projects) bearing a rating of A-5 or better"; also "for protection against sabotage, provided such protection is directed by an authorized federal or state agency."

Limitations On New Construction

Conservation Order L-41, issued April 9, forbids starting any new construction without specific authorization of the War Production Board, except residential construction costing less than $500, farm construction under $1,000, and other construction under $5,000. Projects using critical materials were already controlled by Priorities, but this affects earth dams, masonry structures and the like; the aim being to conserve construction equipment and man power. It apparently does not affect road maintenance or maintenance of any other public work or utility.

Truck Distribution of Water

Should war violence cause such damage to mains as to cut off the water supply to a district for more than a day, some provision should be made for distributing a safe water for domestic purposes until the regular supply can be re-established. This can be in tank trucks, or small containers such as milk cans. Preparedness calls for ascertaining at once where such distributing mediums can be obtained quickly, and planning how to clean, sterilize and use them.

Milk cans should be obtainable from local distributors, and should not require disinfection, but as a precaution it would be well to sterilize them with a solution of 2 lb. of chloride of lime or 1 lb. of HTH or Perchloron to 8 gal. of water. Milk tank trucks can be obtained in many of the larger cities. The street department's watering carts or those used by contractors can be used but should first be thoroughly disinfected.

Gasoline and oil trucks offer more difficulty, because of the taste imparted. They should be steamed with low-pressure steam for 15 or 20 minutes, then thoroughly scrubbed with a high-pressure hot-water jet. Then the tank should be filled to overflowing with safe city water, sterilized and drained.

The water to be distributed will generally be available from city hydrants outside the affected district. Hydrants and hose should be disinfected and both the filling and the supplying of the water to the individual users be so performed as to eliminate all possibility of polluting the water.

Construction Superintendents Wanted for Government Positions

The Civil Service Commission is now accepting applications from superintendents of construction for positions ranging in salary from $3,200 to $6,500 a year. Men are wanted who are thoroughly familiar with the building industry—who know engineering materials, and the standards of good workmanship, and who understand the business management of large construction projects, such as the costs, estimates, etc. Experience in the field of general construction, a part of it as general superintendent on large construction projects involving excavation, reinforced concrete, steel, wood, and masonry, is required, varying in degree of responsibility and in length according to the grade of the position for which application is made.

Announcement 217, giving further information, may be obtained, with the proper application forms, at any first- or second-class post office or from the U. S. Civil Service Commission, Washington, D. C.

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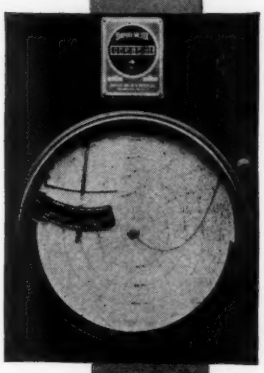

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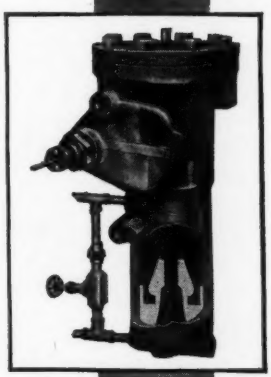

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Poisonous Chemicals and Pathogenic Bacteria in Water Supplies

Among the papers read before a Symposium on Protection of Public Water Supplies During Wartime, held at the University of North Carolina and sponsored by the State Board of Health, was one by J. W. Kellogg, assistant director of the State Laboratory of Hygiene, on "Malicious Water Pollution with Pathogenic Bacterial Cultures," and one by Haywood M. Taylor, Assoc. Prof. of Biochemistry and Toxicology at Duke University, on "Chemical Poisoning of Municipal Water Supplies." Both authors were of the opinion that there was little danger of such pollution.

Mr. Kellogg believes that an epidemic is more likely to be caused by diversion of the attention of health authorities from their routine prophylactic duties than by pollution of the water supply with bacteria; saying that no instances of contamination of water supplies by means of bacterial cultures or poisons had been reported by the British during the first world war nor in the present one up to Dec. 31, 1941.

Concerning chemical poisons, Prof. Taylor said he could find reference to no instances of poisoning by chemicals in either war, except that some supplies had been rendered unfit for use by accidental pollution by poison gases. "To produce a lethal dose of toxic materials in our water supplies would necessitate such large amounts of chemicals as almost to make it prohibitive, both as to cost and as to ability to obtain sufficient toxic material. However, the Japanese are a new and treacherous adversary and may use novel methods of warfare."

Among the pathogens that might be introduced, perhaps the most important is the parasitic amoeba, the cause of amoebic dysentery. Others are typhoid and para-typhoid bacilli, dysentery bacilli, and cholera vibrio, all of which are destroyed by proper chlorination. Amoeba cysts are removed by filtration; but might persist for days if introduced into the water after it had passed the filter.

The only war gases that might be dangerous in the water supply are those (1) Which produce arsenic in water solution, such as Lewisite-methyl dichloroarsine, ethyl dichloroarsine, etc. (2) Which produce cyanide—as diphenyl cyanoarsine. (3) Mustard gas, and (4) Chlorpicrin. Based on arsenic, these are toxic at around 0.15 p.p.m.

In protection against these war gases, chemical treatment is largely ineffective. Many of them are liquid-insoluble in water so that decantation, sedimentation, filtration, etc., play a most important part. After separation of the toxic liquids and solids in this water, the water will generally purify itself in a short time by hydrolysis of the remaining materials. Mustard gas may be removed by boiling for 15 minutes, or eight to nine day storage at 12° C. Chlorine destroys it in a few hours.

Chlorpicrin, however, does not hydrolyze or respond to chemical treatment and the only effective treatment is to empty the reservoirs.

In general in dealing with water contaminated with war gases, the best treatment is filtration, chlorination and allow to stand so that hydrolysis may take place. Of course, if the gas is an arsenic-containing one, this treatment does no good, and emptying of reservoirs is about all that can be done.

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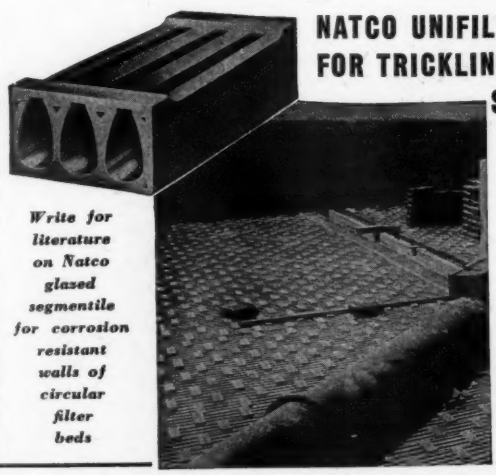

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Keeping Gravel-Surfaced Roads Free From Corrugations

(Continued from page 34)

likely to cause heaving or frost boils should be removed and replaced by those that do not cause these conditions. Among the soils that are affected by such conditions are top soils or those having a large amount of organic matter, fine sands or silts and certain fine clays, and these should be replaced by coarse sands and gravel types. The problem of stabilizing or consolidating sand and gravel subgrades that have been built of these materials is also important This requires the proper selection and use of binder soils during the construction and the proper mixing of them with loose and unstable sand or gravel in order to have a firm and solid base at least three to six inches thick upon which to place the gravel or wearing surface.

3. The use of well-graded and properly processed gravel cannot be too strongly stressed. Too often, on many county and township roads, gravel has been used as it came from the pit, including stones larger than a man's fist, and this oversize material in time became imbedded firmly in the subgrade. Surface blading cannot possibly be satisfactory where such large particles protrude above the surface; bounding and chattering of the blade cause a newly bladed surface to develop corrugations under very light or moderate traffic soon after the blade has passed.

Screening of all pit-run gravel or the crushing of oversize particles is necessary. It is not desirable to include particles that will not pass a 1-inch square opening. Where crushing is specified, ¾-inch size should be the maximum. The proper grading of all screened or crushed material is important. The use of materials with an excess of fines should be avoided, as they have a tendency to pulverize too easily into dust and proper consolidation is difficult, resulting in an excessive amount of loose float. The presence of such float or loose gravel is one of the primary causes of corrugations and should be avoided.

4. The proper consolidation of the gravel with the subgrade and the binding together of the particles of the aggregates is most important. In many cases this can be accomplished, where the road is subjected to a traffic of only 50 to 100 vehicles a day, by using a light application of well-graded gravel mixed with material bladed from the subgrade to obtain a finished mixture containing from 10% to 20% of binder; but this is possible only if the subgrade consists of clays or other form of binder soil. It is generally advisable, however, to obtain the binder soil from some other source. This should be tested by an experienced soils engineer; also a test should be made of the gravel to determine the amount of binder it already contains. After determining the amount and character of binder soil in the gravel and the "Plasticity Index" of the binder soil, the engineer can then determine the percentage of binder to be used in the mix.

After the aggregates and binders have been thoroughly mixed and spread, the proper compaction of all gravel surfaces by rolling is important. The use of sheepsfoot and pneumatic-tired rollers is advisable. Provision should be made for the application of water to assist in compaction. The use of some form of moisture-retaining material, such as calcium chloride or salt, is advisable. This can be used integrally with the mix at the rate of about one pound per square yard, or it may be applied to the surface after rolling.

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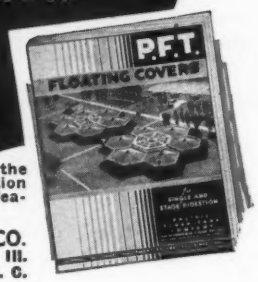

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The subsequent surface application of smaller amounts of these materials once or twice a season or whenever the surface shows dryness is desirable. If the surface is permitted to become dry, it will tend to ravel and corrugate, and, of course, to become dusty, and if it becomes dusty a serious loss of binder soil may result.

5. After the gravel road has been properly constructed, there still remains the job of adequate surface maintenance. The use of good blade equipment in the hands of competent operators is an absolute necessity if a satisfactory riding surface is to be maintained. There are many good makes of power graders and blade machines, but however good the machine may be, the quality of its work is limited by the ability of the operator. Blades should be free of play or chatter, which is bound to occur if operated at too high a speed, doing more damage than good to the road surface. The blading should be done as often as necessary; surfaces that are properly consolidated do not require as frequent blading as those that are not, especially if calcium chloride or salt is used to retain the moisture content. Frequency of blading depends also on the volume of traffic using the highway.

The maintenance of a crown on any gravel road is important. This crown should be not less than 1/3-inch per foot width and may be as high as ¾-inch. A crown of about ½-inch per foot width will allow surface water to drain off and will tend to prevent the formation of pot holes.

Success in building and maintaining gravel roads depends primarily upon the attention given to fundamentals and details. Careless and slipshod methods will result in failures and disappointment. The engineer must be familiar with the materials he has at hand and know how to use them to the best advantage. This is absolutely necessary if the road funds available are to be so used as to give the taxpayer the best results obtainable for each dollar spent.

How Brownwood, Texas, Handled Its Preparedness Boom

(Continued from page 21)

the city administration in eliminating health hazards in the camps outside the city limits, which were out of the jurisdiction of the city itself. The city made arrangements with the state highway department for the use by campers of a small roadside park just outside the city limits, which had adequate sanitary conditions. This alleviated the situation to some extent.

The city commission passed a food control and food-handling ordinance, requiring inspection of all food-handling premises and levying a fee on such establishments amounting to $12 a year. Milk plants also came under this ordinance, the license fee on these ranging from $25 to $150, depending upon the volume of business done by the individual plants. This ordinance not only provided protection for the public but raised about $5,000 of sorely needed additional revenue.

"The next big problem facing the city," Mayor Mayes points out, "was the traffic situation. Our streets, already old, were subjected to ten to fifty times more traffic than normal. Likewise, this flow of traffic congested the streets to such an extent that it was sorely hampering work on the camp, four miles away. We did all we could to keep traffic moving with our small force of officers; but the real bottle-neck occurred on the highway between the city and Camp

Bowie and, as a protection for themselves, the contractors constructing the camp hired a force of 12 special traffic officers. These men were recommended by the highway patrol division of the state safety commission and were deputized by the local sheriff. This arrangement aided greatly the flow of traffic between town and the camp and did much to relieve the traffic situation in the city itself."

Almost immediately, the cost of operating the city jumped approximately 32 per cent. The only tangible increase in revenue was the $5,000 from food handlers' licenses. Naturally the increase in permanent population has added materially to taxable property values, but the city cannot realize any income from this new revenue source for more than a year after the boom problem first became acute. Some additional income has been realized from gas, water and sewer extensions (the city owns these utilities) but the cost of constructing extensions more than offset the increased revenue from this source for the time being.

The city issued revenue bonds for prompt construction of sewer extensions. It began at once to economize and to cut operation costs wherever possible, making it possible to meet the strain of the boom without serious indebtedness and bridge the temporary gap between added expenditures and the added revenue which will come in from increased property values.

"Obviously," said the mayor, "a preparedness boom is a municipal headache, but it is possible for even a small city to cope with it, and profit by it eventually, if it will start in the beginning to meet in a sound way the problems that arise. Organization and an adequate health department is a first step."

Filter Maintenance at the Griffin Water Works

(Continued from page 28)

influent valve. With the chlorine valve cracked, we just barely crack the influent valve and also the rewash valve. With this slow rate of filtering to waste we finally get a chlorine concentration of 40 p.p.m. We now let the filter stand with this high chlorine residual from 8 to 10 hours, and at this time the filter is again washed and agitated. This filter is now ready to be put back into service not only clean and sterile but free from even the smallest mud balls.

The above is a paper read before the Tenth Annual Georgia Water and Sewage School.

Ohio Defense Highway to Reduce Accidents

(Continued from page 32)

pipe plant was constructed and a month later it was operating at near capacity in its goal to manufacture the approximately five miles of 54, 60, and 66-inch pipe, necessary to complete the project. A year later all the pipe had been manufactured.

The drainage system will not only eliminate the traffic hazard but also will alleviate flood conditions of this area, and take care of the surface water from the fields of the numerous farmers whose lands are adjacent. Traffic accidents and deaths should be lessened considerably. Assuming that the eventual improvement of this entire highway between Bowling Green and Perrysburg would result in an accident rate comparable to that computed for the section north of Bowling Green, a reduction of 79 percent over the 1940 totals would be achieved.

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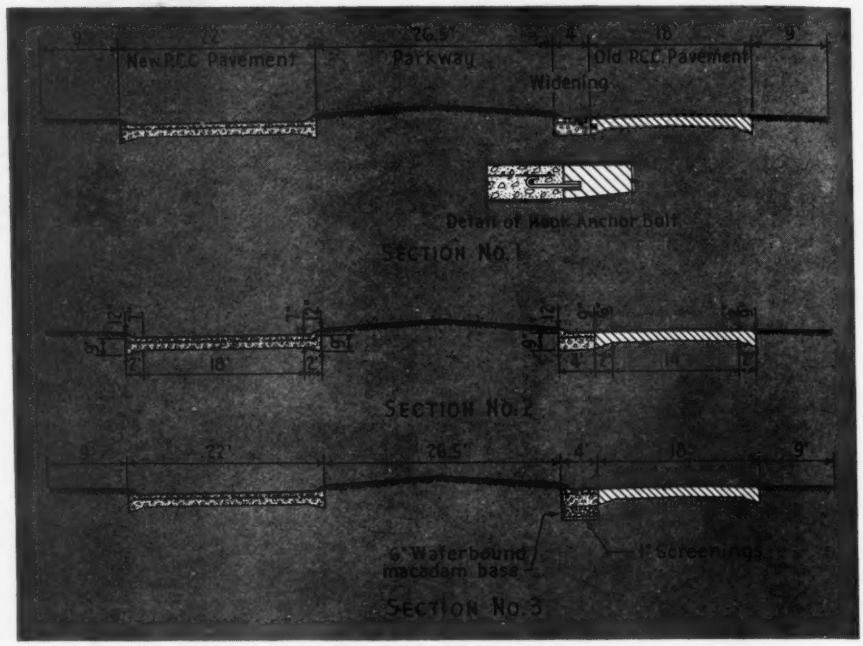
Federal expenditures on this job amount to $506,230 for labor, and $64,923 for non-labor. The State Highway Department, as sponsor for the project, has contributed $24,000 for labor and $261,409 for non-labor.

Widening an 18-Foot Concrete Road

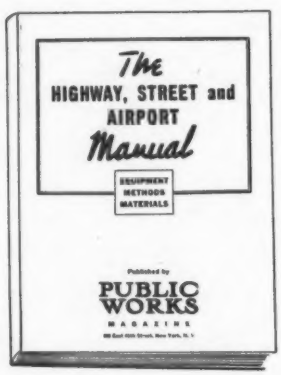
THE U. S. Highway No. 50, entering Kansas City from the southeast, had an 18-ft. concrete pavement which was inadequate in width for carrying the more than 5,000 vehicles per hour that used it, and the old pavement has been widened to 22 ft. and a new 22-ft. one laid with a parkway between for a stretch of over six miles.

At one point about a mile long, widening the road for the new lane would have involved heavy grading through deep rock cuts, and here the new strip was laid on a new location about 1,000 ft. from the old. For the new location, a right-of-way wide enough (up to a maximum of 180 ft.) to accommodate another traffic lane was obtained with a view to ultimately abandoning the old road. At most points new right-of-way was obtained to give a total width of 150.5 ft.

In adding a 4 ft. strip to the existing concrete pavement, three methods were used experimentally to determine which is best. In the first, horizontal holes were drilled in the edge of the old pavement and hook anchor bolts 11 in. long were inserted in lead sleeves and frozen into the drill holes. Anchor bolts were spaced on 5-ft. centers and were hooked



Typical sections of improvement along U. S. 50, showing three methods of joining 4 ft. widening strip to old 18 ft. concrete pavement.



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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

around the inside ¾-in. steel bar forming part of the longitudinal reinforcement of the widening slab. The subgrade for this section was prepared in accordance with standard specifications.

In the second method anchor bolts were omitted, and the subgrade was loosened to a 6-in. depth and wetted, where necessary, then sheeps-foot rolled until 95 per cent compaction was obtained. Prior to placing the subgrade paper, the top 6 in. of subgrade was wetted until the soil had absorbed its normal moisture content.

On pavement widening following the third method, the hook anchor bolts were omitted. The subgrade for the 4-ft. widening strip was prepared in accordance with standard specifications, and made deep enough to receive a bedding of screenings 1 in. thick upon which was placed a 6-in. waterbound macadam base. The 4-ft. widening strip was placed on this waterbound macadam.

The above is abstracted from an article in "Concrete Highways and Public Improvements" by W. H. Burgwin, Division Engineer, Missouri Highway Dept.

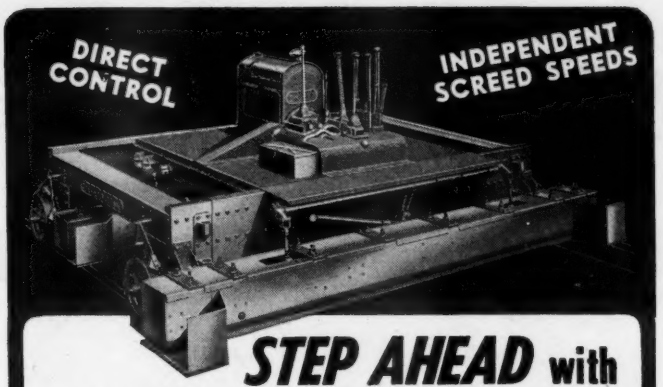
Building an Airport on a Mud Pie

Baltimore, Md., put into regular service on November 16 a new municipal airport on a 360-acre area on the Patapsco river. Most of this area had been filled in by pumping silt from the river behind a bulkhead which was built in 1930, but the silt was of such fine material that it failed to drain out and by 1934 the city had a 360-acre "mud pie," 60 ft. deep in places, with a thin crust on top, which had cost $4,000,000. In 1935 a large amount of coarse granular fill was placed on the mud and this filling continued for four years with discouraging results to show for the $6,400,000 spent.

In November 1939 the WPA took over the project with the understanding that a sound, scientific program be worked out in advance. Ten thousand borings were made to obtain accurate data on depth of mud, to determine where and how deep granular fill should be placed to stabilize the soil. Then placing of granular fill was resumed. As it was placed, the soft material displaced by it was removed, largely by use of power equipment. Where necessary, rollers were used to force the coarse fill down. Thus the runways and triangular areas were filled to a depth of at least 4 ft. More than 600,000 cu. yds. of granular fill was applied, hauled from borrow pits 2 to 4 miles distant, and 300,000 cu. yd. of silt was removed.

The field has four runways varying from 3338 to 4553 feet in length, and from 150 to 200 ft. in width. The runway courses were surfaced by stabilizing the top 6″ of granular fill with emulsified asphalt, and 30,000 sq. yd was given a surface of crushed slag penetrated with asphalt. There are also 25,000 sq. yd. of concrete taxi strips, 20,000 sq. yd. of concrete roadways, 10,000 sq. yd. of 7″ sidewalks, 25,000 sq. yd. of 5″ sidewalks, and 1300 lin. ft. of cement curb. For drainage, WPA laid 7 miles of 6″ to 48″ drain pipe.

The airport is now a regular port of call for three major airlines—Eastern, American and Pennsylvania-Central. It has a modern $210,000 Administration building and a $168,000 hangar, both steel, brick and concrete construction.



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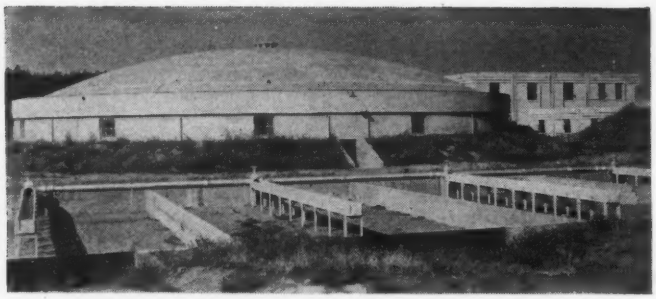


Brainerd sewage treatment plant. Concrete dome covers filter. Hitchcock & Estabrook, engineers.

The Sewerage Digest

Abstracts of the main features of all important articles dealing with sewerage and sewage treatment that appeared in the previous month's periodicals.

Designing Grit Chambers

Two processes take place in a grit chamber—settling of heavy matter, and scouring of the settled solids, the latter being the more effective in separating the organics from the grit. Washing grit during or after removal is necessary for some sewages or if very clean grit is desired. Removal of all sand 0.2 mm and larger removes most of that which gives trouble in treatment plants. To effect this, the ratio of length of settling chamber to its depth must be such that 0.2 mm particles will settle through that depth during the time taken to travel that length. Scour increases with velocity, and the latter should be less than that required to resuspend the settled particles which it is desired to retain.

Instead of controlling velocity by providing two or more channels it is better to use one channel with a control section at the outlet which maintains a constant velocity by varying the depth; of which the Sutro weir is one of the most satisfactory. A rectangular control section (such as the Parshall flume) is satisfactory with a grit chamber of rectangular cross section only if the discharge remains relatively constant; but can be used if the grit chamber has a certain parabolic cross section which gives uniform velocity for all depths of sewage.[C30] *

Sewerage at Army Cantonments

The flow rate of 70 gpd per capita first established for army camps has been found too small; at one large post it averages 135; 100 gpd is now customary. The high rate is partly due to washing mechanized equipment and use of showers, faucets and urinals. Control of such use at one camp reduced the rate 60 gpd per cap. High consumption rate generally is not serious because it only dilutes the sewage; but holidays and week-ends bring crowds of visitors that produce sewage peaks. On the other hand, absence of the men on maneuvers greatly reduces flow. Great care has been taken with grease traps at mess halls, and the results appear to be more satisfactory than in the last war.

In general, the War Dept. provides treatment comparable to that of contiguous areas. Of 38 major cantonments, 10 have primary treatment only (4 with sludge digestion and 5 with chlorination); of those having secondary treatment, 10 have standard trickling filters, 11 high-rate trickling filters, 1 sand filters, and 4 activated sludge; while 2 discharge into city systems. It is difficult to find experienced operators for these plants.[H21]

Treating Tannery Wastes and Garbage

One of the largest industries of Fond du Lac, Wis., population 27,000, is a leather company, waste from which created a nuisance in Lake Winnebago. The industry agreed to pump its waste to the city's treatment plant, where two additional clarifiers were built in 1931, through which it has since been passed, the sludge being drawn off into lagoons. These, with the garbage and rubbish deposited nearby, created a nuisance. It is proposed to solve both the sewage and garbage problem by removing the fleshings and other tannery waste solids by a mechanical screen; construct a new sewage pumping plant to be operated by sludge gas; reduce the moisture content of the tannery sludge to 75% or less in sludge thickening units; install drying and incinerating units to reduce rubbish and dry or incinerate the sludge; grind garbage to be disposed of by digestion; construct a secondary digester with floating cover for gas storage and change existing digesters for 2-stage digestion; and chlorinate the final effluent, also some of the sewers to prevent septic sewage reaching the plant.

The tannery waste contains about 5 tons of lime a day, with a normal pH of 10, forms an excellent floc and settles very rapidly. It is proposed to divert part of this to the domestic sewage, thus increasing the sedimentation of the domestic sewage and increasing the pH to the point of optimum digestion and increase the gas production 75%, and lower the moisture content of the digester sludge. This sludge will contain 1½ to 2% nitrogen, and will be mixed with tannery waste screenings containing 10 to 12% nitrogen before drying, to be sold as fertilizer.[H18]

A.R.P. for Sewage Plant

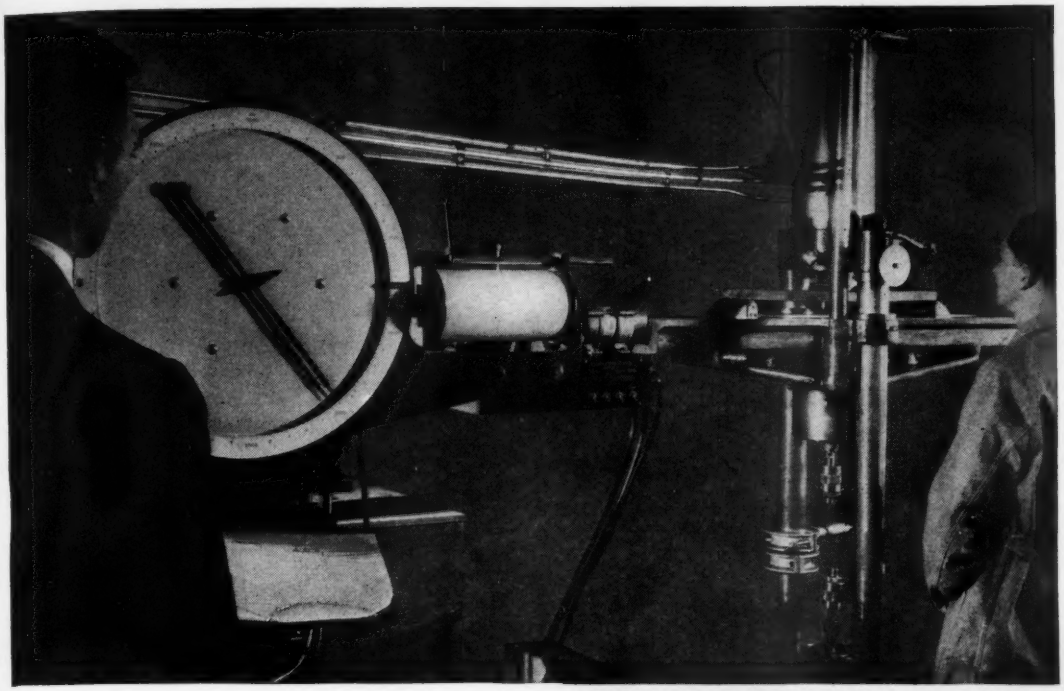
Within 24 hours after the United States declared war, the Buffalo, N. Y., sewage treatment works were making defense preparations; guards were doubled, flood lights installed, fire wardens appointed, flashlights purchased, special lights installed over operating boards, etc., and windows blackened out. It was decided that all plant operations except vacuum filters and incinerators could be maintained during a blackout. In a test on Dec. 26 the works were completely darkened within two minutes.

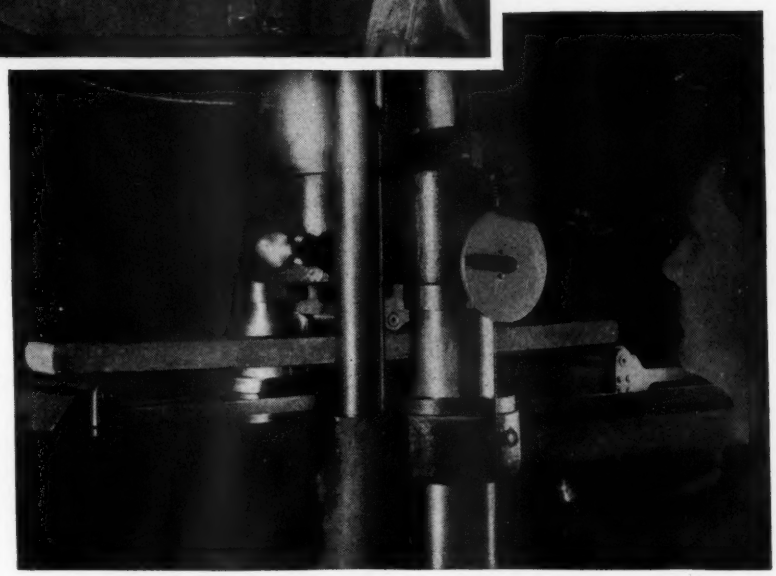
Later, contracts were let for a fence; guards will exclude visitors and inspect all entering trucks. An auxiliary gasoline fire pump was installed; also a police radio receiver. In case of an air raid, all plant operations will cease; in which case it will be 1½ hrs. before any overflow of untreated sewage would occur. Ton chlorine containers are painted dark green and so scattered that there are not more than 3 in a group and each group protected by sand bags; and special arrangements are made to minimize danger from a burst container.[H19]

Copper Sulphate For Clogged Sewers

Ridgewood, N. J., kills roots that clog sewers by means of copper sulphate. For house connections, 2 or 3 lb. are placed in each toilet and flushed down into the house connection, followed at weekly to monthly intervals by lighter doses. If the pipe is entirely clogged it must first be rodded to give some flow. For street sewers, about 2 bb. of the crystals are placed in junction and terminal manholes above the stoppages, being scattered along the invert. This should be done at times of low or normal flow. The copper sulphate solution kills the roots but does not dissolve them, and their decay may take some time. Later,

*See Bibliography in the April issue.





* The "2-inch by 1-inch Test Bar Test," illustrated above, is an acceptance test for cast iron pipe. The breaking load and deflection of the bar, which indicate the physical characteristics of the metal, are determined from this test. It is one of the routine tests made by this Company to insure that the quality of its pipe meets or exceeds the requirements of accepted standard specifications for cast iron pipe. *United States Pipe and Foundry Co., General Offices: Burlington, New Jersey.* Sales Offices in Principal Cities.

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new roots may enter the sewer, and the treatment may be given yearly as a preventive.

Roots in sewers and connections held sewage solids until they putrefied, and the resulting H_2S caused odors at the plant, which it was attempted to control by applying 16 ppm of chlorine to the sewer above the plant. Later, two barrels of copper sulphate were placed in several manholes and killed large quantities of Beggiatoa in the sewers, some pipes being filled with dislodged fungus. This eliminated the odors and chlorination up-sewer was no longer necessary.[G9]

City Sewers Pay Taxes

Englewood, N. J., recently bought the privately owned sewerage system of the city, paying $790,000 for 67 miles of sewers. The rates were reduced 10%; and the income for the first quarter totaled more than $38,000 with less than $200 unpaid. Formerly the city collected from the sewer company taxes exceeding $38,000; and in order that the city taxes should not be reduced by the transfer, the Sewer Division turns over to the general fund $40,000 a year to cover this and other tax charges not readily computed.[J6]

Gravel for Trickling Filters

Long experience at Leeds indicates that gravel, owing to its smoothness, gives a shorter period of contact in a filter than does broken stone or coke, and as a result less purification is obtained. But this smoothness facilitates the purging of the solids and therefore minimizes ponding. Therefore gravel is not desirable where a high quality of effluent is necessary but has much to recommend it where a lower degree of purification is sufficient and trouble-free operation at a high rate is desired. The chief advantage of gravel is its permanence; one bed at Leeds is in good condition after 40 years' service. Unbroken gravel should be used if the advantages of a smooth surface are desired.[D13]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

The Surveyor
March 6

D
13. *p.* High Rate Dosing of Gravel Percolating Beds. By John T. Thompson. Pp. 85-87.

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14. *p.* High Rate Dosing of Gravel Percolating Beds. Discussion of D13. Pp. 117-118.

Engineering News-Record
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5. Sewage Disposal for a Housing Project. By Herbert Moore. Pp. 61-62.

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6. Water and Sewerage Design Problems in a Boomtown Area. By C. M. Stanley. Pp. 76-78.

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8. Sewage Sludge Sales and Dollar Returns. By Robert W. Frazier. Pp. 118-120.
9. Copper Sulphate as an Aid to Sewer Maintenance and Sewage Treatment. By John W. Hood. Pp. 121-123.
10. Wastes From the Manufacture of Paper From Old Paper Stock. By E. F. Eldridge. Pp. 124-126.

Sewage Works Engineering
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18. Improved Plant Treats Sewage, Tannery Wastes and Garbage. By Jerry Donohue. Pp. 188-192.
19. Preparing the Buffalo Plant Against Air Raid. By John W. Johnson and George E. Symons. Pp. 193-195.
20. Wartime Biologicals Affect Pearl River Plant. By John R. Scovill. Pp. 195-196.
21. *p.* Special Sewage Problems at Army Cantonments. By Charles H. Capen and Howard S. Montin. Pp. 197-198, 217.
22. Validity of Modern Health Laws and Regulations. By Leo T. Parker. Pp. 202, 219.
23. What to Do With Sludge. Pp. 203-204, 221.
24. Fertilizer Manufacture at Chicago Calumet. Pp. 205-206.

American City
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6. A Sewage System Changes Hands. By G. Russell Hartley. P. 50.
7. How New York Is Meeting Its Sewage Treatment Problem. Pp. 73-74, 95.

Civil Engineering
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7. Sewage Disposal in a Southern Army Camp. By Robert M. Lingo. Pp. 206-208.

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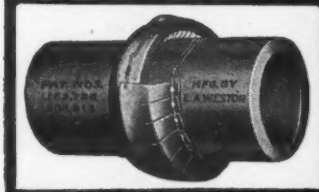
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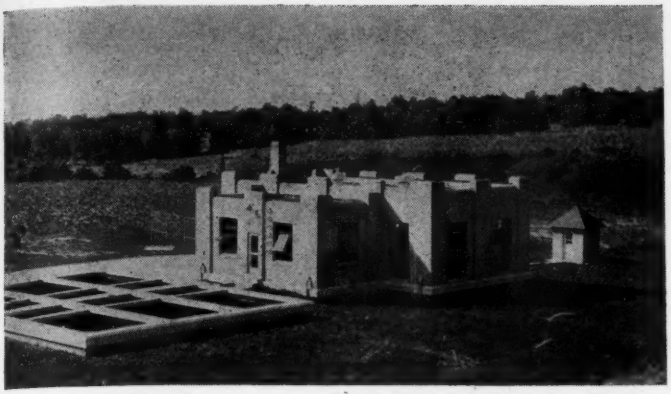


General view of filter and pumping plant, Oldham County, Kentucky

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Replacement Parts for Equipment

The following replacement parts and supplies are the minimum that should be kept on hand at waterworks plants for meters, rate controllers, and rate-of-flow, water level, electric telemeter and wash water gauges. For Venturi Meter Instruments—a main shaft, set of main shaft packing, set of rubber gaskets, 1 lb. of mercury, a pen and pen arm, miscellaneous screws. For Rate-of-flow Controllers—diaphragm, air valve, supply of stuffing box packing or hydraulic cylinder packing. Diaphragm Pendulum Units—diaphragm, flexible hose for stuffing box, spare pilot valve. For Loss-of-head and Rate-of-flow Gauges — an adequate length of "Ashaway" cable, pen and pen arm. For Water Level Gauges—a supply of 1/32 in. phosphor bronze cable. For Telemetering Gauges on Meters—mercoid switch, cam shoe and arm assembly, and spare motor.[A42]

Removing Crenothrix From Mains

Stillwater, Minn., to prevent red water trouble, in 1941 started chloramine treatment, using 32 lbs. of chlorine and 7 lbs. of ammonia per day. The water so treated entered a reservoir, the walls of which were previously covered with an inch thickness of a rust-colored gelatinous mass, which soon sluffed off after treatment began. The same substance was abundant in the mains, and was blown out through fire hydrants. This was aided by stirring up the water in the mains by forcing in compressed air, using a 105 cu. ft. air compressor furnishing air at 100 psi. This was connected to a fire hydrant, two or more other hydrants were opened, and air blown in for a few seconds, then stopped and this repeated until water ran clear from the open hydrants. Too rapid admission of air may cause leaks in the joints of the main.[F41]

Sterilizing Bombed Mains

If a bomb breaks a main, polluting matter may be blown up the main 100 to 200 ft. from the crater, and the main should be sterilized before being put into service. The most convenient way without using expensive machinery is by sodium or calcium hypocholorite or HTH or Perchloron, using enough to give 50 ppm of chlorine to all the water in the pipe being treated. The procedure is as follows (see cut):

After a break has occurred, shut gates 1 and 2, and others, if necessary. Repair the break, but in the meantime connect a chlorinator or pump to the main, upstream from the break. After the break has been repaired, open gate 1 and flush out the pipe line through the hydrant or similar opening. Shut the flush openings and start the chlorinator or force pump, open the one-inch waste pipe, with the water still flowing through the pipe. Inject an amount of chlorine or hypochlorite, the amount determined by dividing the amount of water, in gallons, in the pipe section between the valves by 2,000. This will give the number of gallons needed of ten per cent hypochlorite solution. Now flush out the line by using house services and flush pipes.

Always keep on hand about 20 gal. of a 10% available chlorine stock hypo solution, stored in a dry, cool place; and either a portable gas chlorinator, or a hypochlorinator, or a hydraulic pressure or test pump.[F46]

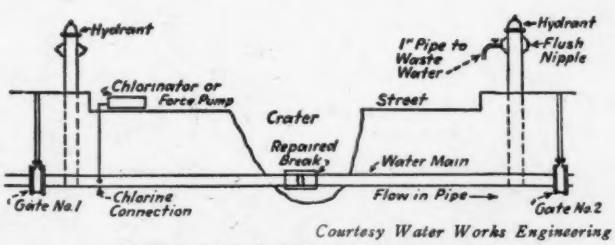
Auxiliary Supply For a Bombed City

The city engineer of Salisbury, Md., recommends that an auxiliary water supply (to serve in case the regular supply be put out of commission) be provided by driven wells and underground pumping stations pumping into the existing distribution system. Entrance to the pumping stations would be through manholes. Pipes to the surface would supply ventilation. Gasoline would be stored in underground tanks nearby. Old automobile engines with belt drive could be used for power, minimizing priority difficulties, and would not be affected by power trouble caused by bombing. The pumps would have flooded suctions, eliminating priming. The water would be safe. The locations of the stations could not be determined by bombers, and the depth would minimize damage. They would be economical.[F38]

Eradicating Water Chestnut

The water chestnut (also called water caltrop) has gained a foothold in several parts of the eastern United States, is very prolific, and the dense masses have a stagnating effect on the water, retaining sewage effluents and favoring mosquito breeding. It germinates in the spring from a nut deposited the previous year, which nut matures the latter part of July. At Fort Belvoir, Va., where the plants covered 1,200 acres, the tops were cut off by two 12 ft. saw-tooth cutting bars operating horizontally in front of a self-propelling boat, and then hauled onto the bank. This is done in May or June, before the nuts mature. On shore, they were spread out and dried, or piled in heaps which decomposed without particularly offensive odors.

A chemical containing paris green was sprayed on one area. It killed the plants, but their decomposition depleted



Courtesy Water Works Engineering

Suggested Method for Sterilizing a Main

the oxygen in the water, which could be avoided by dragging them ashore, as in the cutting method.[G14]

Enslow Continuous Stability Indicator

This indicator, when tried at Durham, N. C., carried the fine calcium carbonate into the effluent if the velocity was high; while if it was low, packing and short-circuiting resulted. This was remedied by placing the fine chalk in a top-shaped "contactor," through which the water passed first, entering at the bottom and leaving at the top; thence flowing up through two tubes of marble chips in series. The contactor has 2 liters capacity, and contains 200 gms. of precipitated calcium carbonate; each tube contains 2½ lb. of marble chips. The normal operating rate is 25 to 35 mls. per minute.

The pH of the stabilizer effluent is lower than that of the treated or tap water, although the alkalinity is the same; therefore the pH readings are disregarded and the effort is made to maintain the final treated water alkalinity equal to that shown by the stabilizer effluent.[G15]

Use of the Reynolds Number

In 1885, Prof. Osborne Reynolds, of the University of Manchester, England, attempted to establish a relation by which experiments on small pipes (mainly as models) may be correlated to actual flow conditions in larger pipes or to flows with liquids of different viscosity. Thus, in practical operation, if an engineer or water superintendent desires to predict what a large pipe, or series of pipes, will do under certain conditions, he has but to construct a small-scale model, conduct experiments, and apply the observed records to the ratios indicated by Reynolds. The result will be the theoretical prediction of final operating conditions. In all problems having to do with flow in pipes and channels, a necessary condition for similarity between model and prototype is that the Reynolds number **R** shall be the same for both. But in the normal course of affairs the waterworks man does not have to worry about the Reynolds number. So long as the velocity is fairly high in a pipe, the flow will be essentially turbulent and the effect of changes in Reynolds number can be neglected.[A59]

Carbon Prevents Algae Growth

Algae growth in a 30 mg reservoir of the St. Louis County Water Co. was killed by use of carbon spread over the surface, which shut out the sunlight and, settling to the bottom, smothered the algae. Carbon fed into the influent water did not spread over the surface. Good distribution was obtained by blowing the carbon onto the reservoir surface by means of a water jet type air exhauster which sucked dry carbon from a bag. With 150 lb. water pressure, 70 lb. of carbon was discharged onto the reservoir in 30 minutes. It was applied daily between 7 and 7:30 A. M., before the light became strong; if the light intensity was extreme, a second application was made shortly after noon. None, of course, was needed at night. During the algae growing season the company used an average of a little less than 100 lb. a day on the 380,000 sq. ft. area.[U3]

Estimating Most Probable Number

The author says that MPN can be calculated by dividing the number of tubes by the square root of [(No. of ml. in negative tubes) x (No. of ml. in all tubes)]; and that numbers so calculated deviate from values given by the usual method by amounts which ordinarily are insignificant. The formula is not restricted as to number of tubes and dilutions, nor as to type of tests. The greater the number of fermentation tubes tested the greater the precision.[A65]

Effects of antibiosis (antagonistic actions of bacteria on coliform organisms) must be considered in the determination of M.P.N. values, especially if larger volumes

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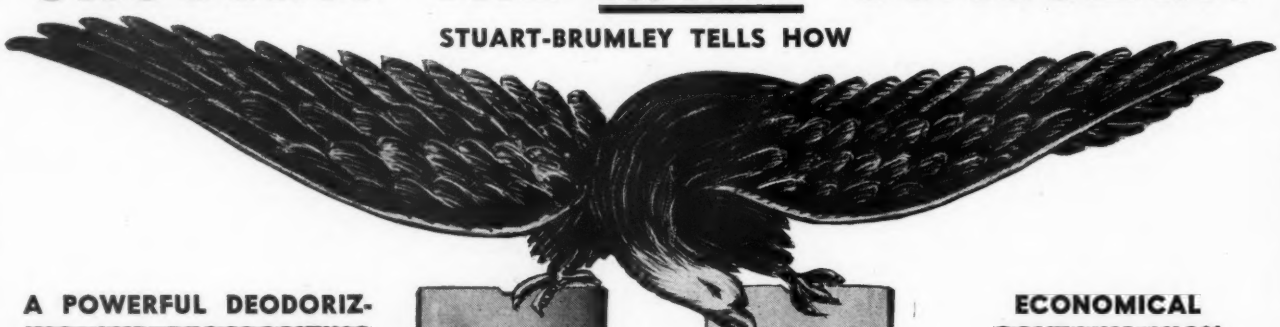

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of water are to be used for inoculation of fermentation tubes.

A system of most probable range (M.P.R.) values is suggested as preferable to the present M.P.N. values for coliform organism concentrations where each of a series of fermentation tubes is inoculated with the same volume of sample. The M.P.R. system does not lend itself to computing average results and would thus prevent covering up a poor result in an average value.

Low concentrations of coliform organisms are better detected by an increase in the number of 10-ml. tubes used rather than by the introduction of 100-ml. tubes.[A66]

Softening by Biological Activity

Chatsworth reservoir, Los Angeles, Calif., 2.25 billion gallons capacity, in May 1940 had a total hardness of 120 ppm. Between June 1 and 5 the hardness suddenly dropped to 90 due to decrease in calcium content. At the same time there was a decided rise in dissolved oxygen, turbidity and pH, and anabaena increased from 750 to 4,730 standard units per milliliter. Investigation and experiments led to the conclusion that the softening was due to biological activity. Organisms shown to utilize sufficient "half-bound" carbon dioxide in their metabolism to cause natural softening include Anabaena, Aphanizomenon, Synedra, Scenedesmus and Cosmarium and probably others.[A68]

Pouring Joints In Wet Pipe

Milwaukee has been replacing many old mains and connecting new pipe to them, and as few of the old valves can be shut absolutely tight, it is impossible to keep water out of the pipe while pouring joints between old and new pipe. In some cases they use a rubber gasket ("Hyde-ro Rubber Ring") which prevents water coming into the joint while it is being poured. This gasket was also used when a leaky joint was cut out and re-poured. In installing a sleeve on a 20" line, a clay dam about 5" high was built in the end of each pipe with a clay bridge to span the 5" gap between the two pipes, over which the water flowed from one pipe to the other while the sleeve was being placed and the joint poured. Afterward the pipe was filled with water and the clay blown out.[A69]

Madison's Watersphere

Madison, Wis., has as water tank a sphere 30 ft. diameter, supported 100 ft. above the ground by a truncated cone base 16 ft. high, 26 ft. diameter at the base tapering to 8 ft. at the top, from which rises a column 80 ft. high, 8 ft. diameter at the base and 6 ft. at the top. This tank cost 6% more than the best designed conventional tank, but was novel and more pleasing in appearance, cost of maintenance painting will be less, and there are no legs which youngsters can climb and fall from. It is designed to withstand a wind velocity of 100 mph. It is painted a green-gray-blue color. It is provided with automatic aeronautical lights, cathodic rust prevention unit, automatic cone valve in the base, and automatic electrical control of pumps to maintain the tank contents within a vertical range of 8 ft.[A70]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

A *Journal, American Water Works Ass'n.*

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55. Relationship of Missouri River Navigation Improvements to Valley Properties. By F. S. Besson. Pp. 475-489.
56. Ground Water in Southeastern Florida. By Wm. P. Cross and S. Kenneth Love. Pp. 490-504.
57. Chemical Character of the Larger Public Water Supplies in Georgia. By Wm. L. Lamar. Pp. 505-512.
58. Some Physical Effects of Bombing. By Herman G. Baity. Pp. 513-522.
59. Trends in Coefficients of Large Pressure Pipes. Discussion. Pp. 523-543.
60. Water Main Extension Policies in Wisconsin. By P. A. Reynolds. Pp. 544-554.

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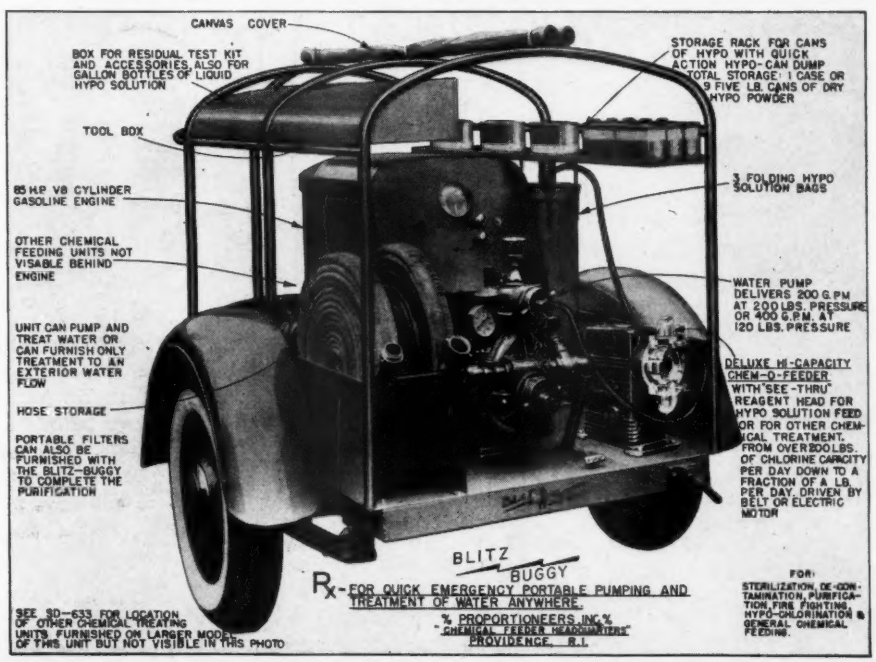
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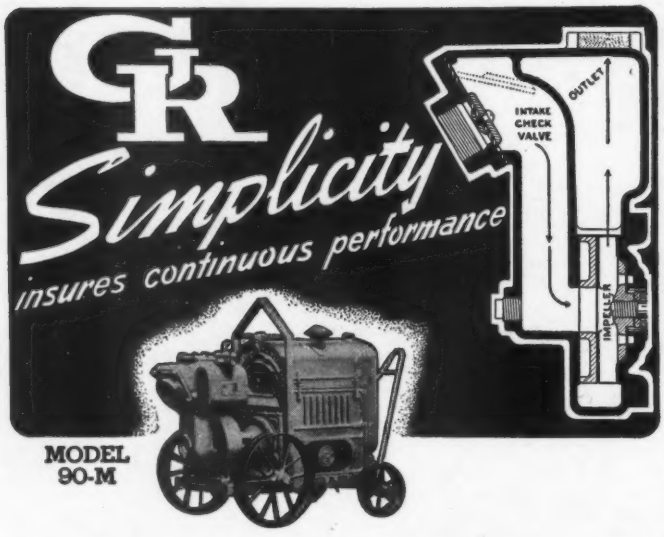

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The hydraulic principles which create the air lock in the "Air Lock" are fully covered and protected in patent papers.

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Sodium Luminaires in Operation at Intersection in Wisconsin

General Electric Co.
Schenectady, N. Y.

The first large system of sodium safety luminaires in Wisconsin has been installed at an interchange intersection on U. S. Route 141 and Wisconsin Route 57 in the town of Grafton, according to A. T. Bleck, construction engineer of the Wisconsin State Highway Commission.

"The primary purpose of these luminaires will be to aid in directing motorists safely through the intersection," he explained. "The sodium light was selected on account of the caution color and the visibility produced."

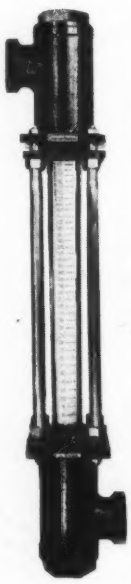
Federal and state funds were used to install the luminaires, which will be State maintained through the Wisconsin Gas and Electric Company and State and County Highway Maintenance Departments.

Fifty-nine General Electric luminaires are used in the system. Each luminaire is equipped with a 10,000-lumen sodium lamp mounted horizontally in an arrangement of open airplane-shaped reflectors designed to produce efficienctly a correct pattern of light distribution on the pavement surface.

Rotameter Sight Flow Meters

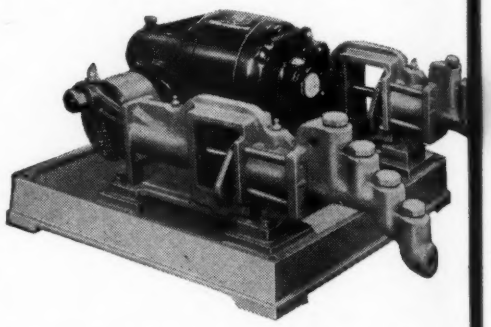
Fischer & Porter Co.
Hatboro, Pa.

Operating Principle and Design: The essential part of the rotameter is a transparent tapered tube set in vertical position with the large end at the top. Inside the tapered tube is a free plumb-bob shaped float in contact only with the fluid to be metered, which flows vertically upward through the tube. The float is supported only by the velocity head of the fluid stream. When no fluid is passing, the float rests on a stop at the bottom of the tube and closes it off due to the fact that its diameter is selected to correspond with that of the smallest portion of the tube. However, as soon as flow upward through the tapered tube commences, the float must rise toward the larger end of the tube to make a passage for the fluid. With a small flow the float rises only a short distance; with a larger flow its rise is greater. For any one particular flow there is one corresponding float position. Actually the position of the float is a measure of the area of the annular opening between the inside of the tube wall and the float, since the head loss created by the float is of necessity the same, regardless of its momentary position in the tube. Hence the rotameter is an "area type" flow meter. Since the rate of flow depends directly on the area of the opening, measuring the area automatically results in rate of flow measurement.



The Rotameter measures Alum solutions, Ferric Sulphate solutions, Chlorine Gas. They are made of corrosion resisting materials, and in sizes to handle flows from a few CC's per minute to 1000 gallons or 1000 cubit feet per minute.

Catalog 10-A contains complete description and will be sent upon request.



Fractional H.P. Duplex Milton Roy Pump.

Chemical Pumps and Proportioners

Milton Roy
1300 East Mermaid Ave., Chestnut Hill
Philadelphia, Pa.

An exclusive feature of this pump is the step-valve. A double-ball checks on both suction and discharge assuring maximum efficiency of displacement, automatic discharge of any small particles of dirt, elimination of air-binding, etc. The design of the entire assembly is such that chambers, ball-checks, seats and pump pistons can be made from any desired metal or alloy (and various plastics) that can be cast or machined. It is claimed that the Roy affords exact control of volume, down to one quart per hour, assuring accurate control of treatment and minimizes waste of material. It is claimed that these pumps are specially adapted for and used for handling all chemicals required for the treatment of municipal water supply and sewage. Catalog No. 941 gives complete information and copies will be mailed upon request.

Conventions and Association Meetings

New York State Sewage Works Association Spring meeting will be held at Hotel Ten Eyck, Albany, June 5th-6th.

American Water Works Assn. annual meeting at Stevens Hotel, Chicago, Ill. June 21-25. Harry E. Jordan, Secty.

The Pennsylvania Sewage Works Association's 1942 Conference will be held at the Penn-Harris Hotel, Harrisburg, Pa., August 25th and 26th.

Pennsylvania Water Works Operators Association—Annual meeting will be held at Penn-Harris Hotel, Harrisburg, August 27th.

Federation of Sewage Works Associations Annual Convention will be held October 15th-17th in Hotel Statler, Cleveland, Ohio.

For the Engineer's Library

Refuse Collection Practice. By the Committee on Refuse Collection and Disposal, American Public Works Ass'n. 659 pages, 221 illustrations. Price $5.00.

This is by far the best, most complete treatise on this subject that has been published in this country. Its comprehensiveness is indicated by the chapter titles: The Refuse Collection Problem. Refuse Materials. Preparation of Refuse for Collection. Factors Affecting the Cost of Refuse Collection. Refuse Collection Methods. Refuse Collection Equipment. Planning Refuse Collection Operations. Supplemental Transportation of Refuse. Special Refuse Collection Problems. European Practices. Municipal, Contract or Private Collection of Refuse. Financing Refuse Collection Operations. Organization and Personnel. Equipment Management. Reporting, Cost Accounting and Budgeting. Public Relations.

The information and material assembled in this volume is the result of more than two years' research carried on by the Association, under the general direction of its Committee on Refuse Collection and Disposal. Experience and practice in more than 200 cities throughout the United States and Canada comprise the basic data assembled and analyzed in the book.

Surveys of Highway Engineering Positions and Salaries. Am. Soc. of Civil Engineers Manual of Engineering Practice No. 24. By Allen P. Richmond, Jr., Asst. to the Secretary. 80 pp. Price to members, $0.65; to non-members, $1.30.

The purpose of this manual is to outline a set of procedures and documents that may serve as a guide to those interested in inaugurating a survey of engineering positions and salaries in an engineering organization. Steps are recommended which, while they do not constitute a merit system such as is found in Civil Service, utilize some of the methods developed in that practice. Appended are first drafts of grade specifications for four sub-professional grades and seven professional grades, covering the range from inexperienced field or office help to administrative and technical heads of state departments.

New Appointments

New City and County Officials recently reported:

City Engineers

W. J. Ramsay, Scottsboro, Ala.
Creed Caldwell, Pine Bluff, Ark.
A. B. Morris, Jr., Cordele, Ga.
E. W. Powell, Concordia, Kan.
Alex Stroup, Iola, Kan.
C. N. Smitley, Junction City, Kan.
Jno. D. Fielding, Ludlow, Ky.
K. P. Laberteaux, Hastings, Mich.
H. T. McNeely, Iron Mountain, Mich.
A. C. Hanson, Acting, Austin, Minn.
Winston C. Larson, Detroit Lakes, Minn.
Lewis H. Merrill, Hutchinson, Minn.
D. W. Ulmer, Carthage, Mo.
Roger Andrews, Alliance, Neb.
Guy Vroman, Acting, Mamaroneck, N. Y.
Stewart J. Scholer, Rome, N. Y.
Tom Dwyer, Greenville, Ohio.
J. J. Flickinger, Niles, Ohio.
J. E. Fox, Rittman, Ohio.
V. L. Goodnight, Corvallis, Ore.
Samuel G. Fetterman, East Conemaugh (P. O. Johnstown), Pa.
William E. Weigle, York, Pa.
J. C. Reid, Beaumont, Tex.
E. P. Spaulding, Bristol, Va.
F. J. Bergeon, Portsmouth, Va.
J. L. Wentworth, Roanoke, Va.
E. N. Wilkinson, Suffolk, Va.

City Managers

R. B. Meserve, Fernandina, Fla.
A. C. Newman, Leesburg, Fla.
Jack Maynard, Covington, Ky.
George N. Schoonmaker, Toledo, Ohio.

Public Works Commissioners

Albert E. Hart, Lawrence, N. Y.
John W. Meara, Middletown, N. Y.
P. M. Donnell, Lebanon, Tenn.
R. H. Royce, Rutland, Vt.

Water Works Superintendents

D. P. McLachlan, Palo Alto, Calif.
Robert Beck, Willimantic, Conn.
J. M. Brock, Lake Worth, Fla.
Frank Spencer, Greenfield, Ind.
Henry Harter, New Castle, Ind.
Wm. Irwin, Oelwein, Iowa.
Jake Moyer, Junction City, Kan.
N. E. Bruce, Ludlow, Ky.
Elmer W. Bennett, Westboro, Mass.
Edward Schulte, East Detroit, Mich.
John Parnell, Niles, Mich.
Herbert G. Fischer, Duluth, Minn.
Seymour Himle, Montevideo, Minn.
Luther P. King, Fredericktown, Mo.
Frank Waters, Madison, N. J.
H. E. Hutchinson, Princeton, N. J.
Howard McNaney, Auburn, N. Y.
Wm. Marra, Cohoes, N. Y.
Geo. Dielz, Cortland, N. Y.
Nelson M. Fuller, Olean, N. Y.
Wm. Foster, Peekskill, N. Y.
Wm. Schneider, Fremont, Ohio.
Mr. Crownover, Greensburg, Pa.
C. V. Eakin, Grove City, Pa.

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

John Dowling, Shippensburg, Pa.
Dominic Bruno, Helper City, Utah.
A. B. Culmer, Bellingham, Wash.

County Engineers

Sam Tate, Madison Co., Huntsville, Ala.
J. P. Flaherty, Wadena Co., Wadena, Minn.
John T. Maidlow, Putnam Co., Ottawa, Ohio.
Jewett Johnson, Roberts Co., Sisseton, S. D.

LETTERS *(Continued from page 4)*

are going to "be on the firing line" the material they need. May I assure you that this is not a class of undergraduate students, but is a course for men in service, and taught to them during their working day, not during free time

O. NEIL OLSON
Professor and Head
Dept. Civil Engr.

Automatic Personnel for Emergencies

DEPT. OF PUBLIC WORKS
Bureau of Sewers
Chicago, Ill.

Your editorials on page 6 of the PUBLIC WORKS Magazine for March on automatic personnel for emergencies and maintenance of water works and sewerage systems have been read in this office with considerable interest.

As an indication that we agree with you, a copy of a defense plan for sewers for Chicago, which was recently developed, is enclosed herewith. This plan has been the basis of certain communications and assembly drills, as a result of which certain revisions and further details are being worked out.

THOMAS D. GARRY
Supt. of Sewers
A. J. SCHAFMAYER
Asst. Chief Engr. of Sewers

Drinking Water Standards

THE PRINCETON WATER CO.
Princeton, N. J.

It runs in the writer's mind that, somewhere in the last issue of PUBLIC WORKS, mention was made of a book or pamphlet entitled "Drinking Water Standards," by Lowell J. Reed. Can you inform us if a copy of this work is obtainable, and the price.

Thank you.

H. E. HUTCHINSON
Treasurer

Editor's Note: There is a U. S. Public Health Service publication by that title available without charge from their district offices.

A Use for Old Copies

CITY OF GLENWOOD
Glenwood, Iowa

For several years I have been filing my copies of PUBLIC WORKS in the Public Library when I have completed reading them. It might surprise you to know of the general interest that these create among the reading public. I frequently have people ask me about articles which have appeared in it.

HENRY H. DEAN
Civil Engineer

AMERICAN WATER WORKS ASSOCIATION
CONFERENCE ON WARTIME WATER WORKS PROBLEMS

The Stevens Hotel—Chicago
June 21-25, 1942

Monday Morning—June 22
9:30 A.M.

General Session

Administrative Problems of Water Works in Wartime by *H. H. Brown, D. L. Erickson, L. A. Geupel, K. K. King, L. G. Lenhardt* and *H. S. Morse;* The War and Water Rates by *Reeves Newsom.*

Water Purification Division

The Manipulation and Identification of Micro-Organisms by *James B. Lackey.* Control of Micro-Organisms by *L. F. Warrick, F. J. McKee* and *W. Van Horn.* Traveling Laboratory Control of Bottlers Operation by *Bert Wells.* Specifications for Filtering Material; Committee Report by *Paul Hansen, Comm. Chairman.*

Monday Afternoon—June 22
2:00 P.M.

General Session

Introduction to Chicago's Problems by *W. W. De Berard.* Civilian Defense Protection of Chicago's Water Supply by *A. E. Gorman.* Conservation of Critical Materials in Filter Plant Design by *F. G. Gordon.* Chemical Treatment and Equipment for Chicago's South District Filtration Plant by *Paul Hansen* and *J. R. Baylis.* Maintaining Efficiency of Equipment in Chicago's Pumping Stations by *Frank J. McDonough.*

Tuesday Morning—June 23
9:30 A.M.

General Session

Guarding Water Works Property by *Warren J. Scott, Harry U. Fuller* and *H. A. Van Norman.* Effects of Air Attack Upon Utility and Other Structures by *Walter D. Binger.* The Mutual Aid System at Work by *Earl Devendorf, John Murdoch, Howard H. Potter* and *Clarence W. Klassen.*

Tuesday Afternoon—June 23
2:00 P.M.

Plant Management & Operation Division

Good Practice in Water Works Management by *Wendell R. LaDue.* Choosing a Water Works Superintendent (Specifications for) by *Dale L. Maffitt.* Organization and Equipment for Emergency Repair of Distribution Systems. Discussion by *W. Victor Weir* and *B. W. Cullen.*

Water Purification Division

Methods for Determination of Residual Chlorine; Committee Report by *C. K. Calvert, Chairman.* Residual Chlorine and Bacterial Quality by *Max Levine, Austin Heller* and *Richard Bender.* Maintenance of Chlorine Residual in the Distribution System by *Clyde R. Harvill, Major C. Hagar* and *Arthur R. Todd.*

Wednesday Morning—June 24
9:30 A.M.

Joint Session
Plant Management & Operation and Finance & Accounting Divisions

The Omaha Water Works—A Successful Business by *Walter S. Byrne.* Jonesboro's Successful Water Works Business by *Lloyd Rebsamen.* Progress Report—Committee on Survival and Retirement Experience with Water Works Facilities by *E. H. Aldrich.* Current Supply Problems — Round Table by *W. W. DeBerard, Eugene Dugger, G. L. Fugate* and *Marsden Smith.*

Water Purification Division

Conditioning Methods to Inhibit Corrosion; Committee Report by *E. W. Moore, Chairman.* Critical Problems in the Boiler Feedwater Field by *M. C. Schwartz.* Stabilization of Lime-Soda Softened Water by *Chas. P. Hoover, Owen Rice* and *Arthur F. Mellen.* Effect of Water Conditioning on Locomotive Maintenance by *Clarence Knowles.*

Wednesday Afternoon—June 24
2:00 P.M.

General Session

Ground Water—A Vital National Resource—General Nature of the Current Problem by *Dr. O. E. Meinzer.* Midwest Problems by *Chas. B. Burdick.* Southeastern Problems by *Malcolm Pirnie.* Long Island Problems by *Kyle Forrest.* Pacific Coast Problems by *Samuel B. Morris.*

Steel Pipe Committee

Opening Remarks by *W. W. Hurlbut, Chairman.* The Design of Ring Flanges for Steel Water Pipe by *H. O. Hill.* Rehabilitation of Steel Sections of Owens River Aqueduct by *W. W. Hurlbut.* Report of War Production Board Technical Advisory Committee on National Emergency Specifications for Steel Water Pipe by *R. E. Barnard.*

Thursday Morning—June 25
9:30 A.M.

Finance and Accounting

Studies of Consumers' Demand for Water by *Hal F. Smith.* Survey of Billing and Collection Practices in Cities of the 100,000-200,000 Group Prepayment, Penalties, Discounts, Deposits by *Geo. F. Hughes.* Water Bills as a Lien Against Property Served by *H. L. Meites.* The Accounting Manual's Balance Sheet by *Chas. E. Moore.*

Plant Management & Operation

Planning and Operating Storage in Distribution Systems by *J. P. Schwada.* Good and Bad Practices in Maintenance of Elevated Tanks by *Walker B. Davis.* Methods of Handling Street Excavations by *D. D. Gross.* The Use of Compressed Air in Maintenance Work by *LaVerne Trentlage.*

Readers' Service Department

These booklets are FREE but distribution is restricted to those actively engaged in engineering or construction. Use the coupon below or write the manufacturer direct, mentioning PUBLIC WORKS.

Construction Materials and Equipment

Air Raid Shelters

3. New 8 page booklet pictures and describes a corrugated pipe shelter with gas tight end walls, emergency escape tunnel and other desirable features. Armco Drainage Products Assn., Middletown, Ohio.

Asphaltic Limestone

5. Characteristics, methods of laying, and results with cold lay mixture shipped ready to use. Especially adapted to resurfacing old pavements, sealcoats and airport runways. Alabama Asphaltic Limestone Co., Liberty Nat. Life Bldg., Birmingham, Ala.

Bridges

7. Teco Connectors, a new method of structural engineering, to spread the load on a timber joint more equally over the cross-section of the wood is described in new literature available from Timber Engineering Co., Inc., Dept. BS-2, 1337 Connecticut Ave., Washington, D. C.

Cement Dispersion

9. "Economics of Cement Dispersion and Pozzolith" tells the complete story of how cement dispersion reduces water required up to 20% and increases workability 150%. Write The Master Builders Co., Cleveland, Ohio, for a copy.

Cement, Early Strength

11. 64-page manual tells how to speed up year 'round concreting, shows how to secure high early strength and greater workability at temperatures either below or above freezing. Contains many actual examples of practical concreting operations; well illustrated with more than 60 photos, charts, graphs and tables. Calcium Chloride Assn., Penobscot Building, Detroit, Mich.

Cold Mix Plants

15. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Concrete Accelerators

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride and Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

33. Pocket manual of concrete curing with calcium chloride. Complete, handy. Contains useful tables, well illustrated. Write the Columbia Chemical Division, Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, N. Y. C.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Drainage Products Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

73. "Principles of Design of Airport Drainage" and other articles on airport drainage reprinted from PUBLIC WORKS Magazine are being distributed free by Bowerston Shale Co., Bowerston, O., Hancock Brick & Tile Co., Findlay, O., and Columbus Clay Mfg. Co., Blacklick, O. Address anyone of the above for a copy.

Graders, Patrol

105. The Austin-Western 99M Power Grader with its powerful all wheel drive simplifies all construction and maintenance; handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow plowing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Austin-Western Road Machinery Co., Aurora, Ill.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. New "Tarvia Manual" is packed with useful data on how to build and maintain roads with Tarvia. Each step is illustrated with excellent action pictures, 64 pp. 103 ills. Write to The Barrett Div., 40 Rector St., New York, N. Y.

Pumps

120. Interesting new booklet tells how to lengthen the life of your pumps. Explains how a little care will save a lot of wear. Write today for your copy. Homelite Corp., 2403 Riverdale Ave., Portchester, N. Y.

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Retaining Walls

126. Charts showing the design of cellular or bin-type metal retaining walls, helpful suggestions on their use for stabilizing slopes, preventing stream encroachment, and solving problems of limited right of way, and construction details are given in a 16-page bulletin entitled, "ARMCO Bin-Type Retaining Walls." It is published by the Armco Drainage Products Association, Middletown, Ohio, and member companies. Ask for Bulletin H-37.

Road Building and Maintenance

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Gallon Iron Works & Mfg. Co., Gallon, Ohio.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No Palmer St., Milwaukee, Wis.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

140. This well-illustrated 16-page catalog describes the tandem, autocrat, cadet, and roll-a-plane rollers, and explains what each is intended to accomplish. Write Austin-Western Road Mach. Co., Aurora, Ill.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principals and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Alkali Corporation, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York City.

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing The steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Div., 40 Rector St., New York, N. Y.

Spreader

187. Jaeger Paving equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Street and Paving Maintenance

190. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments with completely submerged pumps, two heaters, surface heaters, util-Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attanks, road brooms, portable trail-o-roll-

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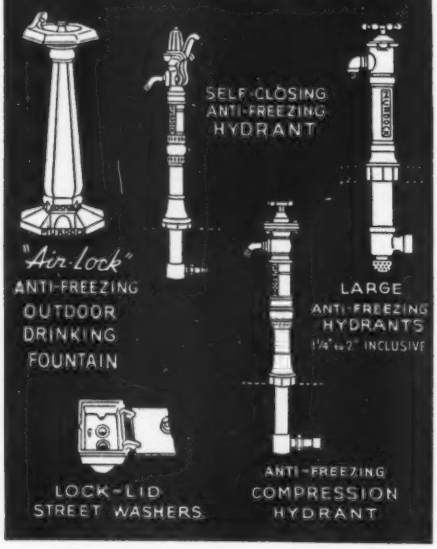
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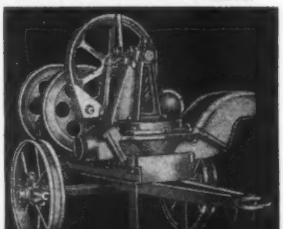

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ers, etc. These are all described in detail and illustrated. The modern and up-to-date equipment for blacktop airport and road construction and maintenance is based upon experience and engineering research over a period of 42 years. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati, O.

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

212. "Are You Annoyed by Dust?" an illustrated circular telling how to prevent dust with calcium chloride. Sent free by Michigan Alkali Co., 60 East 42 St., New York, N. Y.

Small Town Manual

250. Part 1 tells "How you can win the war at home," Part 2 "How you can improve business in your town." In a communication received from the Department, it is stated "We'd like to see the Manual in the hands of every man and woman who lives in a small town who wants to help win the war—and to build his community and the country around it as well." Copies of the Manual may be had by writing to the Department of Commerce, Washington, D. C.

Snow Fighting

Snow Plows

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Alkali Co., Ford Bldg., Detroit, Mich., tells how to use calcium chloride for modern ice control.

Sanitary Engineering

Activated Alum

354. "Technical Data on Activated Alum and Dustless Blackalum" points out the analytical side of Activated Alum and Blackalum. Write Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

Aero-Filter

356. "Results Produced by Aero-Filters" is a new pamphlet covering results at Temple, Texas; Paris, Ill.; Webster City, Iowa; and Mason, Mich. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Air Release Valves

357. Automatic Air Release Valves for water, sewage and industrial uses are described and illustrated in new catalog issued by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

376. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Chlorinators, Portable

380. Complete data on new portable chlorinator designed to meet emergency calls quickly and efficiently. Write Wallace & Tiernan Co., Inc., Newark, N. J.

381. "Emergency Sterilization Equipment," a new bulletin describing the advantages of Dual Drive Chlor-O-Feeders which can serve as either a permanent chemical feeder or as a portable emergency chlorinator. Order from Proportioneers, Inc., 96 Codding St., Providence, R. I.

Cleaning Sewers With Own Forces

383. A 20-page booklet describes and illustrates a full line of sewer cleaning equipment—Rods, Root Cutters, Buckets, Nozzles and Flushers. Write W. H. Stewart (Pioneer Mfr. since 1901), Jacksonville, Fla., or P. O. Box 767, Syracuse, N. Y.

384. A new 32-page, illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boul., Los Angeles, Calif.

Consulting Engineers

385. "Who, What, Why" outlines briefly the functions of the consulting chemist and chemical engineer. Covers various methods of cooperation, on different types of problems, with industry, with attorneys and with individuals. Foster D. Snell, Inc., 305 Washington St., Brooklyn, N. Y., will send a copy on request.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Flow Meters

393. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others — and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Gauges

398. The full line of Simplex gauges for filtration plants are illustrated and described in catalog issued by Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Manhole Covers and Inlets

402. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend, Ind.

Meters, Venturi

406. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders-Providence, Inc., Codding St., Providence, R. I.

Pipe, Cast Iron

408. Handbook of Universal Cast Iron Pipe and Fittings, pocket size, 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., 386 Fourth Ave., New York, N. Y.

409. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

410. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Repair Materials

413. Repair clamps and saddles for steel and cast iron pipe; pipe line clamps; pipe joint clamps and many other handy and economical tools for the water works man. Catalog 41. M. B. Skinner Company, South Bend, Ind.

Pipe, Transite

414. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pipe, 2-inch Cast Iron

417. Generously illustrated booklet describes McWane 2-inch cast iron pipe and its manufacture in streamlined pipe shop. Write McWane Cast Iron Pipe Co., Birmingham, Ala.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Reservoirs, Concrete

431. Data on how large reservoirs may be built at a saving as units by the Wm. S. Hewett System of reinforced concrete construction will be sent without obligation. The Wm. S. Hewett System, 20 N. Wacker Dr., Chicago, Ill.

Screens

434. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

Sewers

437. "ARMCO Sewers" is the title of a 48-page booklet describing the structural and other advantages of ARMCO Ingot Iron. Paved Invert and Asbestos-Bonded pipe for storm and sanitary sewers. Design data and large charts will be found helpful by engineers engaged in the design or construction of sewers. Copies will be sent on request by the Armco Drainage Products Association, Middletown, Ohio, or its associated member companies.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

443. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Softening

444. This folder explains the process of Zeolite water softening and describes and illustrates the full line of equipment for that purpose made by the Graver Tank & Mfg. Co., 4809-15 Tod Ave., East Chicago, Ind. Write for a copy of this instructive folder.

Sprinkling Filters

445. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

Swimming Pools

446. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Taste and Odor Control

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

Treatment

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewarage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

461. Preflocculation without chemicals with the Dorrco Clariflocculator in a single structure is the subject of a new booklet issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York, N. Y.

Valves (See Gates, Air Release, etc.)

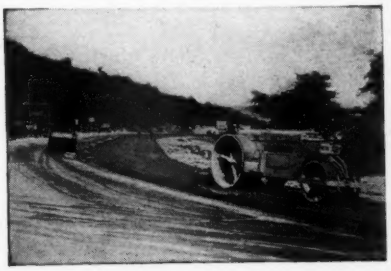
Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

Water Service Devices

500. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati, Ohio.

"Why Use Two— When ONE Will Do"



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To prevent scouring and undermining ARMCO sheeting was driven into the streambed 30 inches from the abutment face. J-bolts anchored the sheeting and a firm footing was provided by cleaning and filling the open space with concrete.

A Saving Hint ON BRIDGE MAINTENANCE

• When scouring or undermining weakens bridge abutments here is a helpful hint: Use ARMCO Sheeting to assure a firm footing, reduce maintenance and protect the bridge structure.

Then you will have the same advantages that make ARMCO Sheeting ideal for trench work, cofferdams, cut-off walls and bulkheads. The corrugated metal design provides ample strength without excessive weight, which means quick, easy handling. It drives fast because of the small displacement area and smooth surfaces. On temporary jobs you can pull ARMCO Sheeting again and again for re-use. Individual units nest snugly together for space-saving in storage or transit.

An ARMCO Sheeting is supplied for every purpose—Flange Type, Clip-Type and Interlocking. Write for data. Armco Drainage Products Assn., 125 Curtis Street, Middletown, Ohio.

ARMCO SHEETING

INDUSTRIAL MOVIES

In this column each month we shall review motion pictures that are available to our readers for showing to engineering groups. Unless otherwise stated films are available on two weeks notice and without charge.

Health and the Cycle of Water

16mm, Black and white, sound film, 2 reels, 20 minutes or 3 reels, 30 minutes.

This film, as the title suggests, is the story of the cycle of water starting at the source and then being followed through the filtration plant, into the home, back through the sewers, through the sewage treatment plant and outfall to the sea where it is again evaporated and condensed and the cycle repeated endlessly. Supplied in two forms. The two reel being entirely educational with no advertising and the three reel which includes records and tests of the Cast Iron Pipe laboratory. Apply to Thomas E. Wolfe, Research Engineer, Cast Iron Pipe Assn., Peoples Gas Building, Chicago, Ill.

Dustless Low Cost Roads and Streets

16mm, Black and white, sound film, 20 minutes.

"Dustless Low Cost Roads and Streets" deals with the uses of calcium chloride for dust abatement, surface consolidation and stabilization on gravel or stone roads. Any engineering group having the use of a 16mm sound on film projector may borrow this film by writing to the Calcium Chloride Assn., 4145 Penobscot Bldg., Detroit, Mich.

Earthmoving Takes Wings

16mm, Black and white, sound film, 20 minutes.

This movie illustrates the operation of the LeTourneau high-speed Tournapulls on construction projects throughout the United States and Canada. When requesting give both the date it will be shown and the date on which it will be returned. Write to Eugene E. Weyeneth, News Bureau, R. G. LeTourneau, Inc., Peoria, Ill.

Soil Cement Stabilization

16mm, Black and white, sound film, 500 feet.

This is a brand new movie to be ready after May 15, 1942. It is devoted to explaining and illustrating the complete cycle of operations required and the tools necessary, involved in soil cement construction. Available on request from the Allis Chalmers Manufacturing Company, Tractor Division. Milwaukee, Wisc.

Other interesting industrial motion pictures were reviewed in the April issue. Copies of that issue may be obtained for 35c in stamps by writing PUBLIC WORKS Magazine, 310 East 45th St., New York, N. Y.

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